

(19)



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Office européen des brevets



(11)

EP 0 612 004 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:
26.03.1997 Bulletin 1997/13

(51) Int Cl.⁶: **G05B 19/042, A61M 5/172**

(21) Application number: **94100246.1**

(22) Date of filing: **10.01.1994**

(54) Configuration control system for configuring multiple biomedical devices

Konfigurationssteuerungssystem zur Konfigurierung mehrerer biomedizinischen Vorrichtungen

Système de commande de configuration pour configurer des dispositifs biomédicaux multiples

(84) Designated Contracting States:
DE FR GB

(30) Priority: **15.01.1993 US 5249**

(43) Date of publication of application:
24.08.1994 Bulletin 1994/34

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Description

BACKGROUND

The invention relates generally to configuring biomedical devices, and more particularly, to a system for configuring multiple biomedical devices identically.

Configuration of a single biomedical device, such as an infusion pump, may take from several minutes to an hour, or longer, to accomplish. Configuration can involve setting the maximum infusion rate, setting the air-in-line alarm threshold level, setting the maximum pressure that can be applied by the pump, and other parameters. When several to hundreds of such biomedical devices must be configured, a significant amount of time is required by skilled personnel. Typically, a biotechnical engineer on the hospital staff or available from another source individually configures each of the biomedical devices as required. This can result in substantial personnel costs to the hospital as well as a substantial down time during which the pumps are undergoing reconfiguration and are unavailable for use.

In many cases, a large number of the same type of biomedical devices must be configured identically. For example, all infusion pumps in a neonatal ward may have the identical alarm threshold levels, identical maximum infusion rates, and other operational parameters. In the case where each of the infusion devices used in the ward must be configured individually, a substantial amount of time may be required before all pumps are available for use.

An additional consideration is determining what configuration any particular biomedical device has once it has been configured. In many cases, it is not apparent what that configuration is, nor is it easily determinable. An example for an infusion pump may be the rate range. A pump configured for a neonatal rate range of from 0.1 to 99.9 ml/hr would be unsuitable for use on an adult in an emergency requiring an infusion at a rate greater than 100 ml/hr. In many cases in pumps today, the configuration of the pump is not apparent unless the pump has been switched "on." And even when switched on in some such cases, the rate range is still not discernible by the operator in the normal operating mode of the device. The rate range limits can only be known from documentation that may be accompanying the device or by a service routine to be performed by a biotechnical engineer.

Infusion pumps, as well as other devices, are often kept in reserve in a "central supply" where they can be checked out for use as required. Many devices having different configurations may be shelved together in such a supply area. It is imperative that the device checked out have the configuration desired by the operator.

Additionally, in hospitals and other institutions, devices may be loaned or passed from one area of the institution to another. Not being able to rapidly and accurately determine the configuration of the device can result in a

slower transfer process. The operator receiving the device may be surprised by a different user interface or, worse, by different performance characteristics which may not suit the patient's needs. Another device must then be obtained with the commensurate loss of time. The constant display of a device's configuration would assist in obtaining devices from a central supply and in the transfer of devices between different hospital areas and would alert a potential user that a device needs reconfiguration before its next use.

In some prior biomedical devices, the configuration is only visible at the time the configuration process is performed. That is, the configuration name or identifier is displayed temporarily at the time the device is configured by the biotechnical engineer but is not thereafter available. Documents must be carried with the device to determine its configuration. In some other biomedical devices, the configuration is displayed only at initial power-on of the device. It is not available when the device is in a powered-off state. In another approach, the external cases of devices are made to look different, such as, given different colors. In another approach, the devices are given different model numbers for different configurations. Disadvantages to these approaches include that the device configuration cannot be easily changed by the customer and separate devices must be obtained for different applications.

In another prior approach, certain sets of configurations are pre-installed in the device, one of which can be selected through a menu offered as part of the maintenance routine of the device. The biotechnical engineer selects one of the configurations offered and the device automatically configures itself with the parameters corresponding to that selected configuration. However, custom configurations and configuration names are not available with such an approach and the configuration name is not apparent while the device is switched off.

Hence, those concerned with the use, configuration, and reconfiguration of a plurality of like biomedical devices, and particularly those concerned with such configuration aspects on devices having large numbers of configurable parameters, have recognized the need for an improved, relatively simple, economical, durable, and reliable system for more rapidly configuring such devices and for indicating the set configuration to users and potential users. The present invention fulfills these needs and others.

SUMMARY OF THE INVENTION

The present invention may in one aspect be summarized as an apparatus for controlling a second device to have the configuration of a first device, the apparatus comprising: a first input device connected to the first device which selects the values of operational parameters and configures the first device with those operational parameters, and which selects a configuration teach mode in the first device; a first processor disposed in the first

device which detects the operational parameters of the first device; a second processor disposed in the second device which detects the operational parameters of the second device; a second input device connected to the second device which selects a configuration learn mode in the second device; a communications link connected between the first and second devices and coupled to the first and second processors; wherein the first processor is responsive to the teach mode command through the first input device to provide selected operational parameters to the second device through the communications link; wherein the second processor is responsive to the learn mode command to receive the selected operational parameters provided by the first device on the communications link and configure the second device according to those received selected parameters, and to provide a signal on the communications link to the first processor that said configuration of the second device is complete; a first display disposed on the first device responsive to the configuration complete signal received from the second device and indicating that the configuration of the second device is complete; and a second display disposed on the second device responsive to the configuration complete signal from the second processor for indicating that the configuration of the second device is complete.

It may in another aspect be summarized as a method for controlling a second device to have the configuration of a first device, comprising the steps of: setting the first device into a configuration mode; configuring the first device with a plurality of operational parameters; connecting a communications link between the first and second devices for communicating data between the two; setting the first device into a teach mode; setting the second device into a learn mode; transmitting the configuration of the first device to the second device over the communications link; accepting the configuration of the first device received by the second device over the communications link and configuring the second device accordingly; and indicating at the first and second devices that the configuration control process was successful.

Briefly, and in general terms, the present invention resides in a new and improved system for configuring a second biomedical device in the same configuration as a first device. In one aspect, the first device is configured with operational parameters as desired and then is connected through a communication link to the second device to be configured. After completing such connection, a teach mode is invoked in the first device and a learn mode invoked in the second device. Certain operational parameters set in the first device are then communicated to the second device which receives and accepts such configuration. The second device then becomes configured identically to the first device. The second device indicates acceptance of the configuration by indicating to the first device that the configuration control process is complete. Both the first and second devices

indicate by means of respective displays that the reprogramming of the configuration of the second device is complete.

In another aspect in accordance with the invention, the first device compares each of its operational parameters to the default operational parameters of the second device and communicates only those parameters which differ. Increased speed in communications and less likelihood of error results from this feature.

Before any configuration data is communicated to the second device, the first device requires the second device to identify itself. The first device then compares the identification data received from the second device to acceptable identification data stored in the first device. If the identification data received from the second device does not agree with the identification data stored in the first device, the first device will not send configuration data to the second device but will instead provide a prompt to the operator indicating such status. In the event that the identification data of the second device is acceptable to the first device, the first device will communicate the configuration data to the second device and both devices will indicate a successful transfer of data.

In a further aspect in accordance with the invention, the configuration control system will issue a reminder prompt to the operator if the configuration of the device has been changed and the operator attempts to switch off the power to the device involved or send the new configuration to a second device without first assigning a configuration name. The operator may then assign a configuration name or may continue with the power-off operation or the teach operation in which case the prompt will be overridden and the present name assigned to this configuration. However, such a prompt will not be given in the case of a learn device which was just re-configured by a teach device.

The operator may assign a multi-character name to the configuration set in the first device, which may comprise letters or numbers or both, and which becomes a part of the configuration. The first device will communicate this configuration name to the second device and that name will become part of the configuration of the second device as well as other downloaded parameters. In accordance with this latter feature, the operator is able to configure the device with custom configurations and is able to provide custom configuration names. As a result, more configurations and configuration names are available than with past systems and users can instantly determine the configuration of each device. Each configuration control system includes a continuously powered display mounted on the device for continually displaying that assigned multi-character configuration name, even during conditions of power-off.

The above and other advantages of the present invention will become apparent from the following detailed description of preferred embodiments when taken in conjunction with the accompanying drawings of an illus-

trative embodiment.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic diagram of the connection of first and second devices through a communications link in accordance with one aspect of the invention; FIG. 2 is a block diagram of a system for configuring a second device in accordance with a first device; FIG. 3 is a flow chart demonstrating a method in accordance with the principles of the invention in which a first device is set into a teach mode and transfers its configuration to a second device; FIG. 4 is a flow chart demonstrating a method in accordance with the principles of the invention in which a second device is set into a learn mode and receives its configuration from a first device; FIG. 5 is a sample front panel diagram of a device which may be used to transfer a configuration to a second device; FIGS. 6A, 6B, and 6C demonstrate front panel displays of configuration modes; FIGS. 7A through 7D are sample displays of the teach mode of a first device; FIGS. 8A through 8D are sample displays of the learn mode of a second device; and FIG. 9 is a sample display of a prompt given when a name is not assigned a new configuration.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings with more particularity, wherein like reference numerals designate like or corresponding elements among the several views, there is shown in FIG. 1 a configuration control system 10 for configuring multiple biomedical devices. The control system 10 comprises in this illustration an input device 12 such as a keypad, a processor 14 which receives signals from the input device 12 and responds to them, a display 16 which presents information from the processor 14 to an operator, a memory 18 for storing data and programs, and a communications port 20 for establishing a communications link 22 with another device 24.

An application of the configuration control system discussed above is shown in FIG. 2. In this figure, a first infusion pump 26 is shown connected to a second infusion pump 28 through a communications link 22. Data is passed between them as will be described below in greater detail. The communications link in this case comprises a serial cable 22 connected between serial ports 30 and 32 of the first and second pumps respectively. The RS-232C standard is used in this embodiment. As also will be described below in more detail, each device 26 and 28 has a display 34 and 36 respectively which continuously indicates the configuration of the device, regardless of whether the device is powered or not powered. In the case of FIGS. 2, 5, 6A, 7C, 8C,

and 9 the configuration name PICU (Pediatric Intensive Care Unit) is displayed.

Referring now to FIG. 3, a method embodying the principles of the invention is shown. A first device, designated the "teacher" is placed into the "teach" mode 44. The teacher then begins polling the communications link for a response from a second device. An identify request 46 is sent and a timer is started 48 which provides a fifteen-second period of time within which the teacher is to receive the identification. The teacher then waits 50 for the receipt of serial data. If no data is received within the fifteen seconds, a timeout occurs 52 and the identification request is again sent 46. In the event that serial data is received, the teacher considers itself to be connected 54 and it then displays a message indicating that data is being transferred 56. If the data received is an identification string 58, the teacher compares it to acceptable identifications 60 stored in the memory of the teacher device to verify that the second device is compatible with the teacher. The timer is then stopped 62.

The learn-teach feature is assigned its own configuration management version number, separate from the software version of the device. This allows devices which have different versions of software to transfer their configurations to one another as long as the configuration portions of the software have not been impacted by the change in software.

The teacher then starts with its first configuration parameter 64 and compares that configuration parameter to the corresponding default configuration parameter in the second device 66. In accordance with this embodiment, the teacher includes in its memory all default configuration parameters of compatible learner devices. The teacher thus compares its present configuration parameters to the default parameters stored in its memory. If the parameters are unequal, the teacher device converts the parameter data to ASCII form 68, formats a command 70, and sends the configuration parameter to the second or learner device 72. A second timer is started 74 and the teacher device waits for a correct response from the learner device 76. If a response is received indicating that the command string was acceptable 78, the timer is stopped 80 and the teacher device determines if the last parameter was sent 82. If more parameters remain, the teacher device moves to the next parameter 84 and the process is repeated.

In the case where the current configuration parameter of the teacher unit equals the default parameter value 66, the teacher device does not send the parameter to the learner device but instead proceeds to determine if this was the last configuration parameter 82, and if not, moves to the next parameter 84 as discussed above. A result of this feature is that the teacher device only sends configuration parameters which differ from those already in the learner device.

After sending a configuration parameter, the timer is monitored 86 and if the fifteen second limit is met, the configuration control process is terminated 88 and a

message displayed to the operator that the process was "unsuccessful." If the time limit has not been met, the teacher continues to wait for serial data 76 and the indication that the command string was acceptable 78.

In the event that the parameter was the last parameter 82, the teacher then sends an acceptance request 90 to the learner device, and a third timer is started 92. The teacher device then waits to receive serial data 94, for the command string indicating acceptance to be received 96 and then considers the configuration control to be successful 98. A "successful" display is then provided 100 to the operator.

Once confirmed, the configuration name is displayed in a special reflective LCD display on the front panel of the device. This display along with its driver require very little drive current and are thus suitable to be kept active regardless of the power status of the device.

If the timer times out 102 before receiving the acceptance signal or if the configuration is not acceptable to the learner 96 because of CRC mismatch error, for example, the teacher then terminates the configuration control process 88. Otherwise, the teacher continues to wait for serial data 94.

Turning now to the configuration control process of the second or learner device, reference to FIG. 4 is made. The learner device is placed into a learn mode 110 and as yet is considered to be in an unconnected state 112. The default configuration of the learner device is copied into its temporary working buffer 114 and the receipt of serial data is awaited 116. Upon receipt of serial data, the learner device is considered to be in a connected mode 118 and the device displays "downloading" to the operator.

Upon receiving the command string requesting identification 122, the learner device sends an ID command response which comprises identification data, such as its model number, its software revision number, its learn/teach revision number and its serial number to the teacher device 124. A timer is started 126 and the learner device waits for the receipt of serial data 128. Upon receiving serial data, the timer is stopped 130 and the received command string is reviewed to determine if it is a request for acceptance 132. If it is not such a request, the command string is evaluated for validity 134 by comparing it to a stored table of acceptable commands and determining that it is the correct data type. The command string is then used to look up the parameter data type (for example integer, float, etc.) 136 and is converted from ASCII to the configuration parameter data type 138. The configuration parameter is then stored in the temporary buffer 140 of the learner device and an OK indication sent to the teacher device. The learner device then starts the timer 126 and waits for the receipt of the next configuration parameter 128. If a timeout 144 is encountered before serial data is received, the configuration control process is terminated 146 and a display of "unsuccessful" provided to the operator 148.

When a request for acceptance is received from the teacher device 132, the learner device calculates the cyclic redundancy check (CRC) of the configuration parameters stored in the temporary work buffer, except for the CRC location, 150 and compares the calculated number with the CRC number received from the teacher device 152. If they match, the learner device sends an OK signal to the teacher device 154 and copies the buffer-stored parameters into permanent storage locations in RAM 156 and EEPROM. The EEPROM provides a configuration backup storage means for times when power to the device is completely removed. The learner device then displays "successful" to the operator 164.

However, if the CRC codes did not match 152, the learner device would send a CRC mismatch error signal to the teacher device 166 and then terminate the configuration transfer process 146 and display "unsuccessful" 148.

The use of error detection routines in serial communications is well known to those skilled in the art. In particular, cyclic redundancy checks (CRC) are well known and are often used. In the embodiments shown herein, a 16-bit CCITT CRC polynomial is used although others may function adequately. See J. Campbell, C Programmer's Guide to Serial Communications, Howard W. Sams & Company, 1987, pages. 66-68.

In one embodiment, data communications take the following ASCII form:

MA500.0

where "MA" in this case is a two character initial command string identifier for the maximum pressure limit and "500.0" is the value to be transferred. Other identifiers are usable such as "KV" for the keep-vein-open rate. Each two-character identifier is followed by data having a fixed length for each identifier. That is, the length of data following the "MA" identifier may differ from the data length following the "KV" identifier. However, the length of data following each "MA" identifier is always the same, or fixed.

Turning now to FIG. 5, in which there is shown the front panel 170 of an infusion pump to which the configuration control apparatus and method of the invention may be applied. The front panel includes a main display 172 with which the operator of the configuration control system interacts. Shown in FIG. 5, the main display 172 is presenting operational parameter data; however, as will be discussed and shown in more detail below, the display 172 is also used to configure the learner devices.

The front panel 170 also includes a continuously powered configuration display 174, which in this case, presents four characters to identify the present configuration of the infusion pump. The letters "PICU" have been selected in this case and stand for pediatric intensive care unit; however, in accordance with one aspect of the invention, the operator may select any characters to indicate the configuration of the device. Also included with the front panel is a keypad 176 for the operator's use in entering data and issuing commands. In this em-

bodiment, the pump includes "soft" keys which are available for the operator's use in sending commands to the processor. A first set of three soft keys 178 and a second set of four soft keys 186 are shown in FIG. 5; however, more or fewer may be included with the device as needed. These keys have the function as programmed by the current mode of the processor, as will be shown in reference to the following figures.

Referring now to FIG. 6A, the main display 172 is shown and is indicating that the processor is in the configuration mode. The serial number (ID No.) of the device is presented with the software revision number (SW Rev.) and the configuration identifier. In this case, the configuration identifier comprises eight characters. The first four characters are the computed CRC and the second four are the operator-assigned configuration name. The first four characters are automatically assigned by the processor as the CRC number corresponding to that configuration. The second four operator-assigned characters are assigned to the configuration, actually becoming a part of the configuration. The second set of four characters of the identifier would be the configuration name and could be, for example, the initials of the hospital area such as PICU (discussed above), ICU (intensive care unit) or OR1 (operating room 1), or others. The use of an error detection routine such as CRC combined with a configuration name result in it being very unlikely that two instruments which have the same identifier will not have the same configuration.

A continuation of the configuration menu can be obtained from the screen of FIG. 6A by pressing the "soft" key identified as "MORE" and indicated by the bar 180. As can be seen by reference to FIG. 5, this particular bar is placed over the right-most soft key 178. FIG. 6A also presents an organization technique in which each screen is given a unique code. In the screen of FIG. 6A, the code is placed in the upper right-hand corner and is "C1." This indicates that the screen is of the "C" series (in this case "C" representing the configuration menu) and is number "1" in that series. Pressing "MORE" at the right hand arrow moves to number "2" in the menu series.

FIG. 6B presents a second screen coded "C5" which indicates the learn and teach revision numbers. In accordance with one aspect of the invention, each device will include a revision code which will be checked by the teacher device to determine if the learn and teach programs of both devices are compatible. As also shown in FIG. 6B, a bar 182 has been used to establish a soft key entitled "MORE" over the center soft key 178 shown in FIG. 5 which will move the menu to page 4 of the configuration series if pressed. Other soft keys include "LEARN" and "TEACH" which may be pressed to enter the device into the learn or teach mode respectively.

Referring now to FIG. 6C, an example of how one configuration item might be set is presented. Configuration parameters for the air-in-line features of the device

are presented on the main display 172. The upper right-hand corner indicates that this is a subscreen of menu page 2 in the "C" series. Additional soft keys have been indicated along the vertical left edge of the display with two bars 184. As can be seen by reference to FIG. 5, these bars indicate the two lower soft keys 186. Pressing these soft keys 186 causes different choices to be selected on the display. For example, pressing the soft key 186 corresponding to the upper bar in FIG. 6C once will cause the number "200" to be highlighted and the number "100" to be de-emphasized. Confirming this selection can be accomplished by pressing the "confirm" soft key. This will cause 200 microliters to be the air-in-line alarm threshold volume.

In accordance with the configuration control process, a device which may be called the teacher device is manually configured to suit the particular needs of the hospital or area of a hospital or other institution. In the configuration mode of the device, items such as rate range, display language, air-in-line sensitivity, occlusion pressure limits, etc., are set as needed.

After the configuration of the teacher device has been completed, the device may now be switched into the teach mode by pressing the soft key to the left of the characters "Teach" as shown in FIG. 6B. FIG. 7A shows the device in the teach mode. The teach mode may be started by pressing the START soft key in the lower right-hand corner. In the case where the learn device has been properly connected and has the correct identification, the teach device will download parameter data and indicate this status as shown in FIG. 7B. Where all data was successfully downloaded and an identifier assigned, the teach device display will indicate this status as shown in FIG. 7C. However, where an error of some type occurred during configuration control of the learn device, the display of the teach device will indicate "unsuccessful" as shown in FIG. 7D.

As shown in FIG. 7C in the case of a successful configuration, a new learner device may be connected to the teacher device and the "try again" soft key pressed. This will repeat the above configuration process with the new device. This may be repeated until all learner devices have been configured as the teacher device.

Similar screen displays are presented by the learn device during configuration control as is shown in FIGS. 8A through 8D. In FIG. 8A, the learn device has been placed into the learn mode and is awaiting the download of data from the teach device. When data is being downloaded, the display indicates such status as shown in FIG. 8B. When the configuration control was successful, i.e., all parameters were successfully transferred, a display similar to FIG. 8C is presented to the operator. However, when an error arose during data transfer or identification, a display similar to FIG. 8D is presented to the operator. Thus, displays on both devices provide real-time status of the transfer and, if successful, the second device displays the configuration name and the CRC of

its new configuration.

FIG. 9 demonstrates a display presented to the operator which serves as a reminder prompt that a configuration change has been made while no configuration name change has been received by the processor. In some embodiments, an audible prompt may be given as well. This feature gives the operator a chance to rename the new configuration, or retain the same name for a new configuration. Pressing the on/off key will assign that same name (PICU in this case) to the new configuration. On the other hand, the operator may assign a new name by pressing the "rename" soft key. Without this feature, the operator may have inadvertently saved the new configuration under the PICU name thus possibly having a mix of configurations with the same name. The questioning process by this feature alerts the operator of this possibility.

It should be appreciated that the use of infusion pumps above was for illustration purposes only. The invention is not meant to be limited to infusion pumps but may have application to other devices. Additionally, instead of connecting the learn/teach devices together with a physical cable, a wireless link such as an infrared link could be used. The first device and second device could be placed next to each other and communicate with each other through the use of light-emitting and light-sensing diodes contained in each device. This would be convenient for the operator in that a cable would not have to be stored, found, and then connected between the two. Additionally, the possibility of losing the cable would not be a concern with an infrared link. A possible disadvantage is that the cost of the device may be increased due to the cost of the infrared components.

In a further improvement, parallel communications may be used rather than serial communications. Also, other types of displays for displaying the configuration name may be used as long as they do not exceed the cost and power limits of the device. The number of characters selectable for a configuration name could be increased and is constrained only by the cost of displaying them to the user. Additionally, removable storage media in the device may be programmed for proper configuration either by an accessory custom device, a personal computer or other device. Furthermore, the teach device need not be manually configured. The keypad need not be used for the initial configuration; its configuration may be set by connecting the device to a computer which then would download the configuration from a database of predetermined configurations generated offline.

Although the invention has been described and illustrated in the context of a teacher device connecting to and teaching a single learner device, the principles of the invention may apply to the arrangement where a single teacher device is connected to a plurality of learner devices simultaneously, such as through a network. The teacher may adjust its timing and routines to wait until

all learners have identified themselves and have responded to each teacher command.

The concept that a device without the help of any external or custom devices can communicate its configuration to another device of like type can provide significant time savings in configuring multiple devices and provides a significant advantage to users. The configuration control system of the present invention satisfies a long-existing need for an improved, relatively simple, economical, and reliable system for configuring multiple devices identically. Additionally, the system of the invention tends to ensure against mistaken use of inappropriately configured devices.

Claims

1. Apparatus for controlling a plurality of independently programmable and independently operable devices, each device having an identical set of configuration parameters for controlling its operation, each configuration parameter having a range of user-selectable values, to have the same configuration so that the devices may operate independently of each other with the same configuration, the apparatus comprising:

a first switch included in each of the devices which when activated, provides a teach mode signal;

a second switch included in each of the devices which when activated, provides a learn mode signal;

an input device included in each of the devices that selects configuration parameters of the device;

a disconnectable communications link connected between two of the plurality of the independently operable devices that communicates configuration parameters between the two whereby the link may be disconnected from the two devices so that the devices may operate independently of each other;

a processor included in each of the devices that is responsive to the teach mode signal to provide a configuration signal representative of at least one of its user-selected configuration parameter values to the communications link and is responsive to the learn mode signal to receive configuration signals through the communications link that cause the device in the learn mode to be configured identically with the device in the teach mode, and to provide a signal through the communications link indicating that the configuration of the independently operable device is complete and is responsive to character selection signals received from the input device to assign a configuration name to the

current set of configuration parameter values, and provides said configuration name to the device in the learn mode; and
a display disposed on each of the plurality of devices responsive to the configuration complete signal indicating that the configuration of a device is complete.

2. The apparatus of claim 1 wherein each device further comprises a memory in which is stored default configuration parameter values of the other devices of the plurality, wherein

each processor responsive to the teach mode signal compares each of its own configuration parameter values against the stored default configuration parameter values of another device to which it is connected and the processor of which is responsive to the learn mode signal; and

the processor responsive to the teach mode signal provides only the configuration parameter values to the processor responsive to the learn mode signal which differ from the stored default configuration parameter values of the other device, said processor responsive to the teach mode signal downloading the configuration parameter values to the processor responsive to the learn mode signal only after receiving a predetermined signal from the processor responsive to the learn mode signal.

3. The apparatus of claim 2 wherein:

each device further comprises a permanent memory, a non-volatile memory, and a working memory;

each processor stores the configuration parameter values received from the other processor in the working memory; and

upon providing the configuration complete signal, the other processor stores the configuration parameter values from the working memory into both the permanent memory and the non-volatile memory.

4. The apparatus of any of the preceding claims wherein each device

further comprises a memory in which the respective processor stores that name with the current set of configuration parameter values wherein the processor downloads the name to the communications link with the downloaded configuration parameter values.

5. The apparatus of claim 4 wherein:

the name comprises four alpha-numeric characters

which may be selected by the operator; and wherein there is

further a display which continuously displays the name regardless of whether the first device is powered on or off, said display comprising a four character display requiring relatively little drive current located on the front panel of the first device and continuously displaying the configuration name.

6. The apparatus of claim 5 wherein each of the devices:

further comprises a name detector which detects if a new configuration has been stored in the respective device;

determines if the operator has applied a new name to the current configuration;

detects if a predetermined switch has been engaged; and if so

provides a prompt to the operator that a new configuration name has not yet been stored for the new configuration, said name detector deactivating the prompt in the event that the user again engages the predetermined switch after the name prompt has been given.

7. A method for controlling a plurality of independently programmable and independently operable devices, each device having an identical set of configuration parameters for controlling its operation, each configuration parameter having a range of user-selectable values, to have the same configuration, comprising the steps of:

setting a first of said devices into a configuration mode;

configuring the first device with a plurality of user-selected values of configuration parameters;

connecting a disconnectable communications link between the first device and a second device of the plurality of devices for communicating configuration data between the two devices; setting the first device into the teach mode in which mode a processor included in the device provides configuration parameters representative of the user-selected values of the configuration parameters of the device;

setting the second device into the learn mode in which mode the processor included in the device receives the user-selected values of the configuration parameters of the device in the teach mode to configure the device in the learn mode in accordance with those received user-selected values of the configuration parameters;

assigning a user-selected configuration name

- to the current set of user-selected values of the configuration parameters of the device in the teach mode;
 storing that assigned configuration name and associating the user-selected values of the configuration parameters with it;
 transmitting selected values of configuration parameters of the first device to the second independently operable device over the communications link;
 accepting the selected values of the configuration parameters and the configuration name of the first device received by the second device over the communications link and configuring the second device according to those selected values of the configuration parameters received from the first device so that the second independently operable device has the same configuration and configuration name as the first independently operable device;
 indicating at the first and second devices that the configuration control process was successful; and
 disconnecting the communications link between the first device and the second device so that the first and second devices may operate independently of each other with the same configurations.
8. The method of claim 7 wherein the step of transmitting the selected values of the configuration parameters by the first device comprises the step of transmitting only the configuration parameter values to the second device which differ from the corresponding configuration parameter values in the second device and wherein the method further comprises the step of downloading first device configuration parameter values to the second device only after receiving a predetermined identification signal from the second device.
9. The method of claim 7 or 8 wherein:
- the step of transmitting the selected values of the configuration parameters comprises the step of storing in a memory default configuration parameter values of the other devices;
 comparing each of the first device configuration parameter values against the default configuration parameter values stored in said memory;
 and
 transmitting only the first device configuration parameter values to the second processor which differ from the stored default configuration parameter values.
10. The method of claims 7 through 9 wherein the step of configuring the second device comprises storing the configuration parameter values received from the first device in a working memory in the second device; and
 storing the configuration parameter values stored in the working memory in a permanent memory and a non-volatile memory in the second device.
11. The method of any of claims 7 through 10 wherein the step of assigning a user selected configuration name comprises:
- assigning four alpha-numeric characters as the configuration name; and
 continuously displaying the configuration name when power is on and off, wherein the step of displaying comprises displaying the configuration name on a four character display located on the front panel of the device and continuously displaying the configuration name.
12. The method of any of claims 7 through 11 further comprising the steps of:
- detecting if a new configuration has been stored in the respective device;
 determining if a new configuration name has been stored which applies to the currently stored configuration;
 providing a prompt if a predetermined switch has been engaged but a new configuration name has not yet been stored for the new configuration; and deactivating the prompt in the event that the predetermined switch is again engaged after the name prompt has been given.
13. The method any of claims 7 through 12 further comprising the step of providing a prompt if the power-off switch has been engaged or the step of setting the first device into the teach mode has been attempted without first storing a new configuration name for the new configuration.

Patentansprüche

1. Vorrichtung zur Steuerung einer Mehrzahl unabhängig programmierbarer und unabhängig funktionsfähiger Vorrichtungen, wobei jede Vorrichtung eine identische Menge von Konfigurationsparametern zur Steuerung der Betriebsweise der entsprechenden Vorrichtung aufweist, wobei jeder Konfigurationsparameter einen Bereich von dem Benutzer auswählbarer Werte aufweist, um die gleiche Konfiguration vorzusehen, so daß die Vorrichtungen unabhängig voneinander mit der gleichen Konfiguration betrieben werden können, wobei die Vorrichtung folgendes umfaßt:

- einen ersten Schalter, der in jeder der Vorrichtungen vorhanden ist, und der, wenn er aktiviert wird, ein Lehrmodussignal vorsieht;
einen zweiten Schalter, der in jeder der Vorrichtungen vorhanden ist, und der, wenn er aktiviert wird, ein Lernmodussignal vorsieht;
eine Eingabevorrichtung, die in jeder der Vorrichtungen vorhanden ist, und die die Konfigurationsparameter der Vorrichtung auswählt;
einen trennbaren Übermittlungsabschnitt zwischen zwei Vorrichtungen der Mehrzahl unabhängig funktionsfähiger Vorrichtungen, wobei dieser Übermittlungsabschnitt Konfigurationsparameter zwischen den beiden Vorrichtungen übermittelt, wobei der Übermittlungsabschnitt von den beiden Vorrichtungen getrennt werden kann, so daß die Vorrichtungen unabhängig voneinander betrieben werden können;
einen Prozessor, der in jeder der Vorrichtungen vorhanden ist, und der auf das Lehrmodussignal so anspricht, daß er ein Konfigurationssignal an den Übermittlungsabschnitt vorsieht, wobei dieses Signal mindestens einen der von dem Benutzer ausgewählten Konfigurationsparameterwerte darstellt, und wobei der Prozessor auf das Lernmodussignal so anspricht, daß er Konfigurationssignale über den Übermittlungsabschnitt empfängt, wobei diese Signale bewirken, daß die Vorrichtung in dem Lernmodus genauso konfiguriert wird wie die Vorrichtung in dem Lehrmodus, und wobei der Prozessor über den Übermittlungsabschnitt ein Signal vorsieht, das anzeigt, daß die Konfiguration der unabhängig funktionsfähigen Vorrichtung vollständig ist, und wobei der Prozessor auf von der Eingabevorrichtung empfangene Zeichenauswahlsignale so anspricht, daß er der aktuellen Menge von Konfigurationsparameterwerten einen Konfigurationsnamen zuweist, und wobei der Prozessor den genannten Konfigurationsnamen der Vorrichtung in dem Lernmodus zuführt; und
eine Anzeige, die sich an jeder Vorrichtung der Mehrzahl von Vorrichtungen befindet, wobei die Anzeige auf das Konfigurations-Vollständigkeitssignal anspricht und anzeigt, daß die Konfiguration einer Vorrichtung vollständig ist.
2. Vorrichtung nach Anspruch 1, wobei jede Vorrichtung ferner einen Speicher umfaßt, in dem Ausgangswerte der Konfigurationsparameter der anderen Vorrichtungen der Mehrzahl von Vorrichtungen gespeichert sind, wobei
- jeder auf das Lehrmodussignal ansprechende Prozessor alle eigenen Konfigurationsparameterwerte mit den gespeicherten Ausgangswerten der Konfigurationsparameter einer anderen
- Vorrichtung vergleicht, mit der er verbunden ist, und des Prozessors, der auf das Lernmodussignal anspricht; und wobei
- der auf das Lehrmodussignal ansprechende Prozessor dem auf das Lernmodussignal ansprechenden Prozessor nur die Konfigurationsparameterwerte zuführt, die sich von den gespeicherten Ausgangswerten der Konfigurationsparameter der anderen Vorrichtung unterscheiden, wobei der genannte auf das Lehrmodussignal ansprechende Prozessor die Konfigurationsparameterwerte erst dann auf den auf das Lernmodussignal ansprechenden Prozessor herunterlädt, nach dem er ein vorbestimmtes Signal von dem auf das Lernmodussignal ansprechenden Prozessor empfangen hat.
3. Vorrichtung nach Anspruch 2, wobei:
- jede Vorrichtung ferner einen Langzeitspeicher, einen nichtflüchtigen Speicher und einen Arbeitsspeicher umfaßt;
jeder Prozessor die von dem anderen Prozessor empfangenen Konfigurationsparameterwerte in dem Arbeitsspeicher speichert; und wobei
der andere Prozessor nach der Bereitstellung des Konfigurations-Vollständigkeitssignals die Konfigurationsparameterwerte aus dem Arbeitsspeicher in dem Langzeitspeicher und in dem nichtflüchtigen Speicher speichert.
4. Vorrichtung nach einem der vorstehenden Ansprüche, wobei jede Vorrichtung ferner einen Speicher umfaßt, in dem der entsprechende Prozessor den Namen mit der aktuellen Menge von Konfigurationsparameterwerten speichert, wobei der Prozessor den Namen in Verbindung mit den heruntergeladenen Konfigurationsparameterwerten in den Übermittlungsabschnitt herunterlädt.
5. Vorrichtung nach Anspruch 4, wobei:
- der Name vier alphanumerische Zeichen umfaßt, die von dem Benutzer ausgewählt werden können; und wobei eine weitere Anzeige vorgesehen ist, die den Namen immer anzeigt, und zwar unabhängig davon, ob die erste Vorrichtung ein- oder ausgeschaltet ist, wobei die genannte Anzeige eine vierstellige Anzeige aufweist, für die nur eine geringe Antriebsstrommenge an dem Bedienungsfeld der ersten Vorrichtung erforderlich ist, und wobei diese Anzeige den Konfigurationsnamen ununterbrochen anzeigt.
6. Vorrichtung nach Anspruch 5, wobei jede der Vorrichtungen:
- ferner einen Namendetektor umfaßt, der fest-

stellt, wenn eine neue Konfiguration in der entsprechenden Vorrichtung gespeichert worden ist;

feststellt, wenn der Benutzer der aktuellen Konfiguration einen neuen Namen zugewiesen hat; 5
feststellt, ob ein vorbestimmter Schalter betätigt worden ist; und wenn dies der Fall ist, dem Benutzer ein Anforderungszeichen zuführt, daß ein neuer Konfigurationsname für die neue Konfiguration noch nicht gespeichert worden ist, wobei der genannte Namensdetektor 10
das Anforderungszeichen dann deaktiviert, wenn der Benutzer den vorbestimmten Schalter erneut betätigt, nachdem das Namensanforderungszeichen vorgesehen worden ist. 15

7. Verfahren zur Steuerung einer Mehrzahl unabhängig programmierbarer und unabhängig funktionsfähiger Vorrichtungen, wobei jede Vorrichtung eine identische Menge von Konfigurationsparametern 20
zur Steuerung der Betriebsweise der entsprechenden Vorrichtung aufweist, wobei jeder Konfigurationsparameter einen Bereich von dem Benutzer auswählbarer Werte aufweist, um die gleiche Konfiguration vorzusehen, wobei das Verfahren die folgenden Schritte umfaßt: 25

Einstellen einer ersten der genannten Vorrichtungen in einen Konfigurationsmodus; 30
Konfigurieren der ersten Vorrichtung mit einer Mehrzahl durch den Benutzer ausgewählter Konfigurationsparameterwerte;
Zwischenschalten eines trennbaren Übermittlungsabschnittes zwischen die erste Vorrichtung und eine zweite Vorrichtung der Mehrzahl 35
von Vorrichtungen, um Konfigurationsdaten zwischen den beiden Vorrichtungen zu übermitteln;
Einstellen der ersten Vorrichtung in den Lehrmodus, wobei ein in der Vorrichtung vorhandener Prozessor in diesem Modus Konfigurationsparameter vorsieht, die die durch den Benutzer ausgewählten Werte der Konfigurationsparameter der Vorrichtung darstellen; 40
Einstellen der zweiten Vorrichtung in den Lernmodus, wobei der in der Vorrichtung vorhandene Prozessor in diesem Modus die von dem Benutzer ausgewählten Konfigurationsparameterwerte der Vorrichtung in dem Lehrmodus empfängt, um die Vorrichtung in dem Lernmodus gemäß diesen empfangenen, von dem Benutzer ausgewählten Konfigurationsparameterwerten zu konfigurieren; 45
Zuweisen eines von dem Benutzer ausgewählten Konfigurationsnamens in bezug auf die aktuelle Menge von durch den Benutzer ausgewählten Konfigurationsparameterwerten in dem Lehrmodus; 50
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Speichern des zugewiesenen Konfigurationsnamens und Zuordnung der von dem Benutzer ausgewählten Konfigurationsparameterwerte; 5
Übermitteln ausgewählter Konfigurationsparameterwerte der ersten Vorrichtung an die zweite unabhängig funktionsfähige Vorrichtung über den Übermittlungsabschnitt;
Annahme der ausgewählten Konfigurationsparameterwerte und des von der zweiten Vorrichtung über den Übermittlungsabschnitt angenommenen Konfigurationsnamens der ersten Vorrichtung, und Konfigurieren der zweiten Vorrichtung gemäß diesen ausgewählten, von der ersten Vorrichtung empfangenen Konfigurationsparameterwerten, so daß die zweite unabhängig funktionsfähige Vorrichtung die gleiche Konfiguration und den gleichen Konfigurationsnamen wie die erste unabhängig funktionsfähige Vorrichtung aufweist; 10
Anzeigen des erfolgreichen Konfigurationssteuerungsprozesses an der ersten und der zweiten Vorrichtung; und
Trennen des Übermittlungsabschnittes zwischen der ersten Vorrichtung und der zweiten Vorrichtung, so daß die erste und die zweite Vorrichtung mit den gleichen Konfigurationen unabhängig voneinander funktionsfähig sind. 15

8. Verfahren nach Anspruch 7, wobei der Schritt der Übermittlung der ausgewählten Konfigurationsparameterwerte durch die erste Vorrichtung den Schritt der Übermittlung nur der Konfigurationsparameterwerte an die zweite Vorrichtung umfaßt, die sich von den entsprechenden Konfigurationsparametern in der zweiten Vorrichtung unterscheiden, und wobei das Verfahren ferner den Schritt umfaßt, in dem die Konfigurationsparameterwerte der ersten Vorrichtung erst nach dem Empfang eines vorbestimmten Identifikationssignals von der zweiten Vorrichtung heruntergeladen werden. 20

9. Verfahren nach Anspruch 7 oder 8, wobei:

der Schritt der Übermittlung der ausgewählten Konfigurationsparameterwerte den Schritt des Speichers von Ausgangswerten der Konfigurationsparameter der anderen Vorrichtungen in einem Speicher umfaßt; wobei 25
alle Konfigurationsparameterwerte der ersten Vorrichtung mit den in dem genannten Speicher gespeicherten Ausgangswerten der Konfigurationsparameter verglichen werden; und
wobei
nur die Konfigurationsparameterwerte der ersten Vorrichtung zu dem zweiten Prozessor übermittelt werden, die sich von den gespeicherten Ausgangswerten der Konfigurationsparameter unterscheiden. 30

10. Verfahren nach einem der Ansprüche 7 bis 9, wobei der Schritt der Konfiguration der zweiten Vorrichtung das Speichern der von der ersten Vorrichtung empfangenen Konfigurationsparameterwerte in einem Arbeitsspeicher in der zweiten Vorrichtung umfaßt; und wobei
- die in dem Arbeitsspeicher gespeicherten Konfigurationsparameterwerte in einem Langzeitspeicher und in einem nichtflüchtigen Speicher in der zweiten Vorrichtung gespeichert werden.
11. Verfahren nach einem der Ansprüche 7 bis 10, wobei der Schritt der Zuweisung eines von dem Benutzer ausgewählten Konfigurationsnamens folgendes umfaßt:
- Zuweisen von vier alphanumerischen Zeichen als Konfigurationsname; und
- ununterbrochenes Anzeigen des Konfigurationsnamens sowohl im eingeschalteten als auch im ausgeschalteten Zustand, wobei der Schritt des Anzeigens das Anzeigen des Konfigurationsnamens auf einer vierstelligen Anzeige umfaßt, die sich an dem Bedienungsfeld der Vorrichtung befindet, und wobei die Anzeige den Konfigurationsnamen ununterbrochen anzeigt.
12. Verfahren nach einem der Ansprüche 7 bis 11, wobei das Verfahren ferner die folgenden Schritte umfaßt:
- Feststellen, ob eine neue Konfiguration in der entsprechenden Vorrichtung gespeichert worden ist;
- Feststellen, ob ein neuer Konfigurationsname gespeichert worden ist, der auf die aktuell bzw. gegenwärtig gespeicherte Konfiguration zutrifft;
- Erzeugen eines Anforderungszeichens, wenn ein vorbestimmter Schalter aktiviert worden ist, während noch kein neuer Konfigurationsname für die neue Konfiguration gespeichert worden ist; und Deaktivieren des Anforderungszeichens, wenn der vorbestimmte Schalter erneut betätigt wird, nachdem das Namensanforderungszeichen vorgesehen wurde.
13. Verfahren nach einem der Ansprüche 7 bis 12, wobei das Verfahren ferner den Schritt der Bereitstellung eines Anforderungszeichens umfaßt, wenn der Abstellschalter betätigt worden ist, oder wenn die Durchführung des Schrittes zum Einstellen der ersten Vorrichtung in dem Lehrmodus versucht worden ist, ohne davor einen neuen Konfigurationsnamen für die neue Konfiguration zu speichern.

Revendications

1. Appareil pour commander plusieurs dispositifs pouvant être programmés indépendamment et fonctionner indépendamment, chaque dispositif ayant un ensemble identique de paramètres de configuration pour commander son fonctionnement, chaque paramètre de configuration ayant une plage de valeurs que l'utilisateur peut choisir, pour avoir la même configuration, de façon à ce que les dispositifs puissent fonctionner indépendamment les uns des autres avec la même configuration, l'appareil comprenant :
- un premier commutateur inclus dans chacun des dispositifs qui, lorsqu'il est activé, fournit un signal de mode enseignement ;
- un second commutateur inclus dans chacun des dispositifs qui, lorsqu'il est activé, fournit un signal de mode apprentissage ;
- un dispositif d'entrée inclus dans chacun des dispositifs qui sélectionne les paramètres de configuration du dispositif ;
- une liaison de communication, qui peut être déconnectée, connectée entre deux des différents dispositifs pouvant fonctionner indépendamment, qui communique les paramètres de configuration entre les deux dispositifs, de manière à ce que la liaison puisse être déconnectée des deux dispositifs, pour que les dispositifs puissent fonctionner indépendamment l'un de l'autre ;
- un processeur inclus dans chacun des dispositifs qui réagit au signal de mode enseignement pour délivrer un signal de configuration représentatif d'au moins une de ses valeurs de paramètres de configuration choisies par l'utilisateur à la liaison de communication et qui réagit au signal de mode apprentissage pour recevoir des signaux de configuration par l'intermédiaire de la liaison de communication qui configurent le dispositif en mode apprentissage de manière identique au dispositif en mode enseignement, et pour délivrer un signal par l'intermédiaire de la liaison de communication indiquant que la configuration du dispositif pouvant fonctionner indépendamment est terminée, et qui réagit aux signaux de sélection de caractères reçus du dispositif d'entrée pour assigner un nom de configuration à l'ensemble courant de valeurs de paramètres de configuration, et fournit ledit nom de configuration au dispositif en mode apprentissage ; et
- un affichage situé sur chacun des différents dispositifs réagissant au signal de configuration terminée indiquant que la configuration d'un dispositif est terminée.

2. Appareil selon la revendication 1, dans lequel chaque dispositif comprend en outre une mémoire dans laquelle sont stockées les valeurs par défaut des paramètres de configuration des autres dispositifs de la pluralité, dans lequel

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chaque processeur réagissant au signal de mode d'enseignement compare chacune de ses propres valeurs de paramètres de configuration aux valeurs de paramètres de configuration par défaut stockées d'un autre dispositif auquel il est connecté et dont le processeur réagit au signal de mode apprentissage ; et le processeur réagissant au signal de mode enseignement délivre au processeur réagissant au signal de mode apprentissage seulement les valeurs de paramètres de configuration qui diffèrent des valeurs de paramètres de configuration par défaut stockées de l'autre dispositif, ledit processeur réagissant au signal de mode enseignement téléchargeant les valeurs de paramètres de configuration dans le processeur réagissant au signal de mode apprentissage seulement après réception d'un signal prédéterminé émis par le processeur réagissant au signal de mode apprentissage.

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3. Appareil selon la revendication 2, dans lequel :

chaque dispositif comprend en outre une mémoire permanente, une mémoire non volatile et une mémoire de fonctionnement ; chaque processeur stocke les valeurs de paramètres de configuration reçues de l'autre processeur dans la mémoire de fonctionnement ; et lorsqu'il délivre le signal de configuration terminée, l'autre processeur stocke les valeurs de paramètres de configuration provenant de la mémoire de fonctionnement dans la mémoire permanente et dans la mémoire non volatile.

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4. Appareil selon l'une quelconque des revendications précédentes, dans lequel chaque dispositif comprend en outre une mémoire dans laquelle le processeur respectif stocke le nom accompagnant l'ensemble courant de valeurs de paramètres de configuration, le processeur téléchargeant le nom par l'intermédiaire de la liaison de communication avec les valeurs de paramètres de configuration téléchargées.

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5. Appareil selon la revendication 4, dans lequel :

le nom se compose de quatre caractères alphanumériques qui peuvent être choisis par l'opérateur ; et dans lequel il y a en outre un affichage qui affiche le nom en continu, que

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le premier dispositif soit sous tension ou non, ledit affichage comprenant un affichage à quatre caractères nécessitant relativement peu de courant d'entraînement situé sur le panneau avant du premier dispositif et affichant en continu le nom de la configuration.

6. Appareil selon la revendication 5, dans lequel chacun des dispositifs :

comprend en outre un détecteur de nom qui détecte si une nouvelle configuration a été stockée dans le dispositif respectif ; détermine si l'opérateur a appliqué un nouveau nom à la configuration courante ; détecte si un commutateur prédéterminé a été actionné ; et, si c'est le cas, délivre un message à l'opérateur indiquant qu'un nouveau nom de configuration n'a pas encore été stocké pour la nouvelle configuration, ledit détecteur de nom désactivant le message dans le cas où l'utilisateur actionne de nouveau le commutateur prédéterminé après que le message de nom a été donné.

7. Procédé pour commander plusieurs dispositifs pouvant être programmés indépendamment et fonctionner indépendamment, chaque dispositif ayant un ensemble identique de paramètres de configuration pour commander son fonctionnement, chaque paramètre de configuration ayant une plage de valeurs que l'utilisateur peut choisir, de manière à avoir la même configuration, comprenant les étapes consistant à :

mettre un premier desdits dispositifs en mode configuration ; configurer le premier dispositif avec plusieurs valeurs de paramètres de configuration choisies par l'utilisateur ; connecter une liaison de communication pouvant être déconnectée entre le premier dispositif et un deuxième dispositif des différents dispositifs pour transmettre des données de configuration entre les deux dispositifs ; mettre le premier dispositif en mode enseignement, mode dans lequel un processeur inclus dans le dispositif délivre des paramètres de configuration représentatifs des valeurs de paramètres de configuration du dispositif choisies par l'utilisateur ; mettre le deuxième dispositif en mode apprentissage, mode dans lequel le processeur inclus dans le dispositif reçoit les valeurs choisies par l'utilisateur des paramètres de configuration du dispositif en mode enseignement, afin de configurer le dispositif en mode apprentissage conformément à ces valeurs de paramètres de

- configuration choisies par l'utilisateur reçues ; assigner un nom de configuration choisi par l'utilisateur à l'ensemble courant de valeurs choisies par l'utilisateur de paramètres de configuration du dispositif en mode enseignement ; stocker ce nom de configuration assigné et y associer les valeurs de paramètres de configuration choisies par l'utilisateur ; transmettre les valeurs choisies des paramètres de configuration du premier dispositif au deuxième dispositif pouvant fonctionner indépendamment par l'intermédiaire de la liaison de communication ; accepter les valeurs choisies des paramètres de configuration et le nom de configuration du premier dispositif reçus par le deuxième dispositif par l'intermédiaire de la liaison de communication et configurer le deuxième dispositif en fonction de ces valeurs choisies des paramètres de configuration reçues du premier dispositif, de manière à ce que le deuxième dispositif pouvant fonctionner indépendamment ait la même configuration et le même nom de configuration que le premier dispositif pouvant fonctionner indépendamment ; indiquer au premier et au deuxième dispositif que le processus de commande de configuration a été réussi ; et déconnecter la liaison de communication entre le premier dispositif et le deuxième dispositif, de façon à ce que le premier et le deuxième dispositif puissent fonctionner indépendamment l'un de l'autre avec la même configuration.
8. Procédé selon la revendication 7, dans lequel l'étape consistant à transmettre les valeurs choisies des paramètres de configuration du premier dispositif comprend l'étape consistant à transmettre au deuxième dispositif seulement les valeurs des paramètres de configuration qui diffèrent des valeurs de paramètres de configuration correspondantes dans le deuxième dispositif, et dans lequel le procédé comprend en outre l'étape consistant à télécharger les valeurs des paramètres de configuration du premier dispositif dans le deuxième dispositif seulement après réception d'un signal d'identification prédéterminé émis par le deuxième dispositif.
9. Procédé selon la revendication 7 ou 8, dans lequel :
- l'étape consistant à transmettre les valeurs de paramètres de configuration choisies comprend l'étape consistant à stocker dans une mémoire les valeurs de paramètres de configuration par défaut des autres dispositifs ; comparer chacune des valeurs de paramètres de configuration du premier dispositif avec les valeurs de paramètres de configuration par défaut stockées dans ladite mémoire ; et transmettre au deuxième processeur seulement les valeurs de paramètres de configuration du premier dispositif qui diffèrent des valeurs de paramètres de configuration par défaut stockées.
10. Procédé selon les revendications 7 à 9, dans lequel l'étape consistant à configurer le deuxième dispositif comprend le fait de stocker les valeurs des paramètres de configuration reçues du premier dispositif dans une mémoire de fonctionnement dans le deuxième dispositif ; et stocker les valeurs des paramètres de configuration stockées dans la mémoire de fonctionnement dans une mémoire permanente et dans une mémoire non volatile dans le deuxième dispositif.
11. Procédé selon l'une quelconque des revendications 7 à 10, dans lequel l'étape consistant à assigner un nom de configuration choisi par l'utilisateur comprend le fait de :
- assigner quatre caractères alphanumériques en tant que nom de configuration ; et afficher en continu le nom de configuration sous tension ou hors tension, où l'étape d'affichage comprend le fait d'afficher le nom de la configuration sur un affichage à quatre caractères situé sur le panneau avant du dispositif et d'afficher en continu le nom de la configuration.
12. Procédé selon l'une quelconque des revendications 7 à 11, comprenant en outre les étapes consistant à :
- détecter si une nouvelle configuration a été stockée dans le dispositif respectif ; déterminer si un nouveau nom de configuration a été stocké qui s'applique à la configuration couramment stockée ; délivrer un message si un commutateur prédéterminé a été actionné mais un nouveau nom de configuration n'a pas encore été stocké pour la nouvelle configuration ; et désactiver le message dans le cas où le commutateur prédéterminé est de nouveau actionné après que le message de nom a été donné.
13. Procédé selon l'une quelconque des revendications 7 à 12, comprenant en outre l'étape consistant à délivrer un message si le commutateur de mise sous tension a été actionné ou si l'étape consistant à mettre le premier dispositif en mode enseignement a été tentée sans avoir d'abord stocké un nouveau nom de configuration pour la nouvelle configuration.

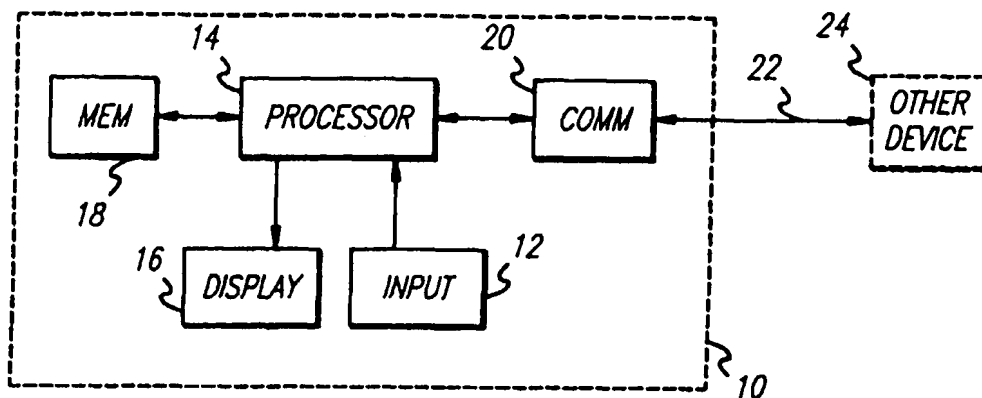


FIG. 1

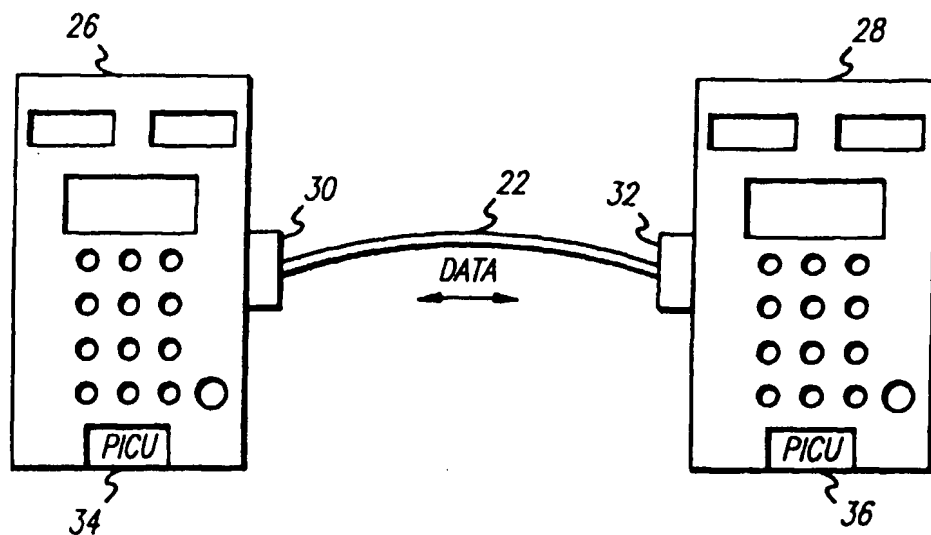


FIG. 2

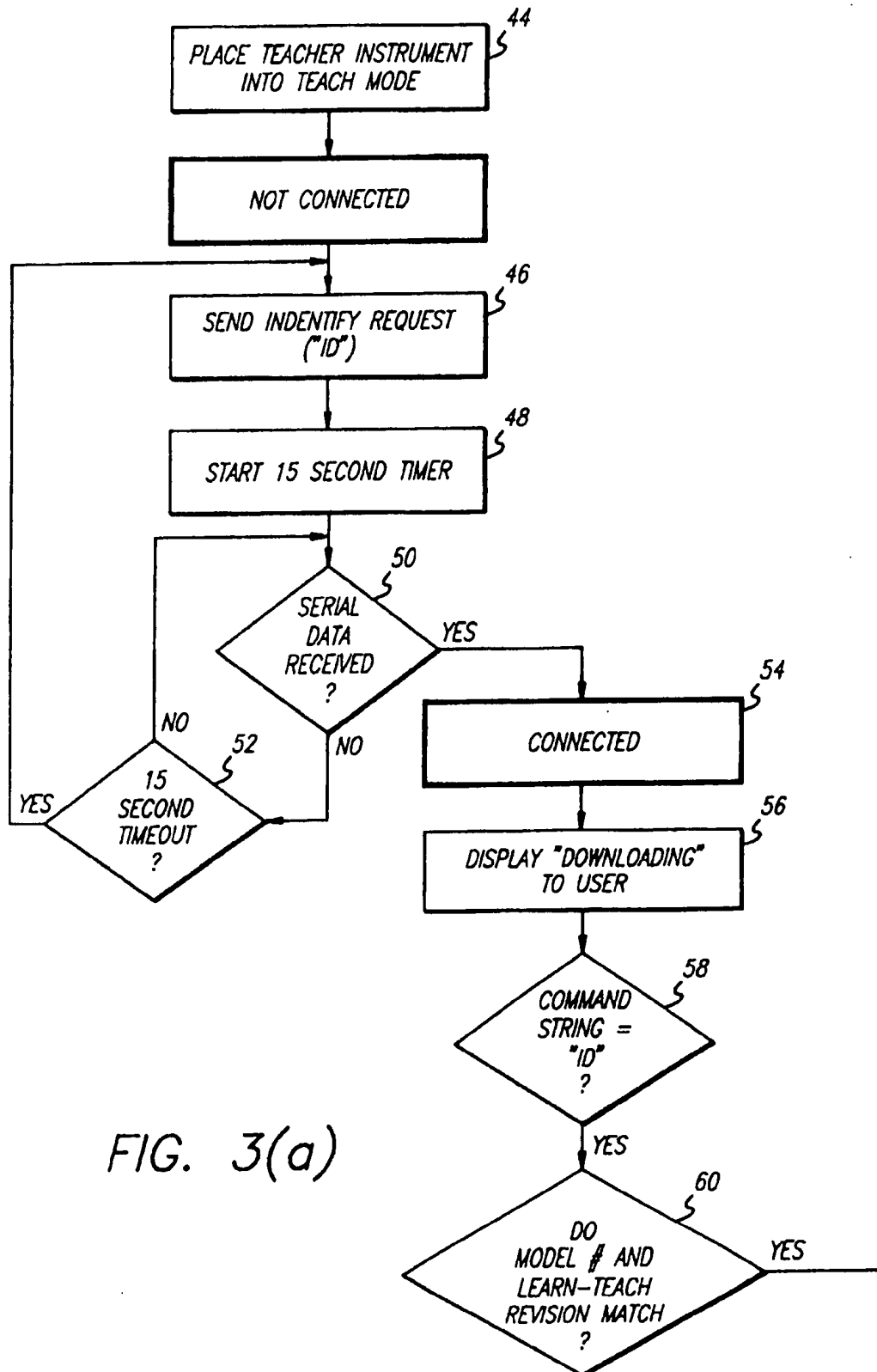


FIG. 3(b)

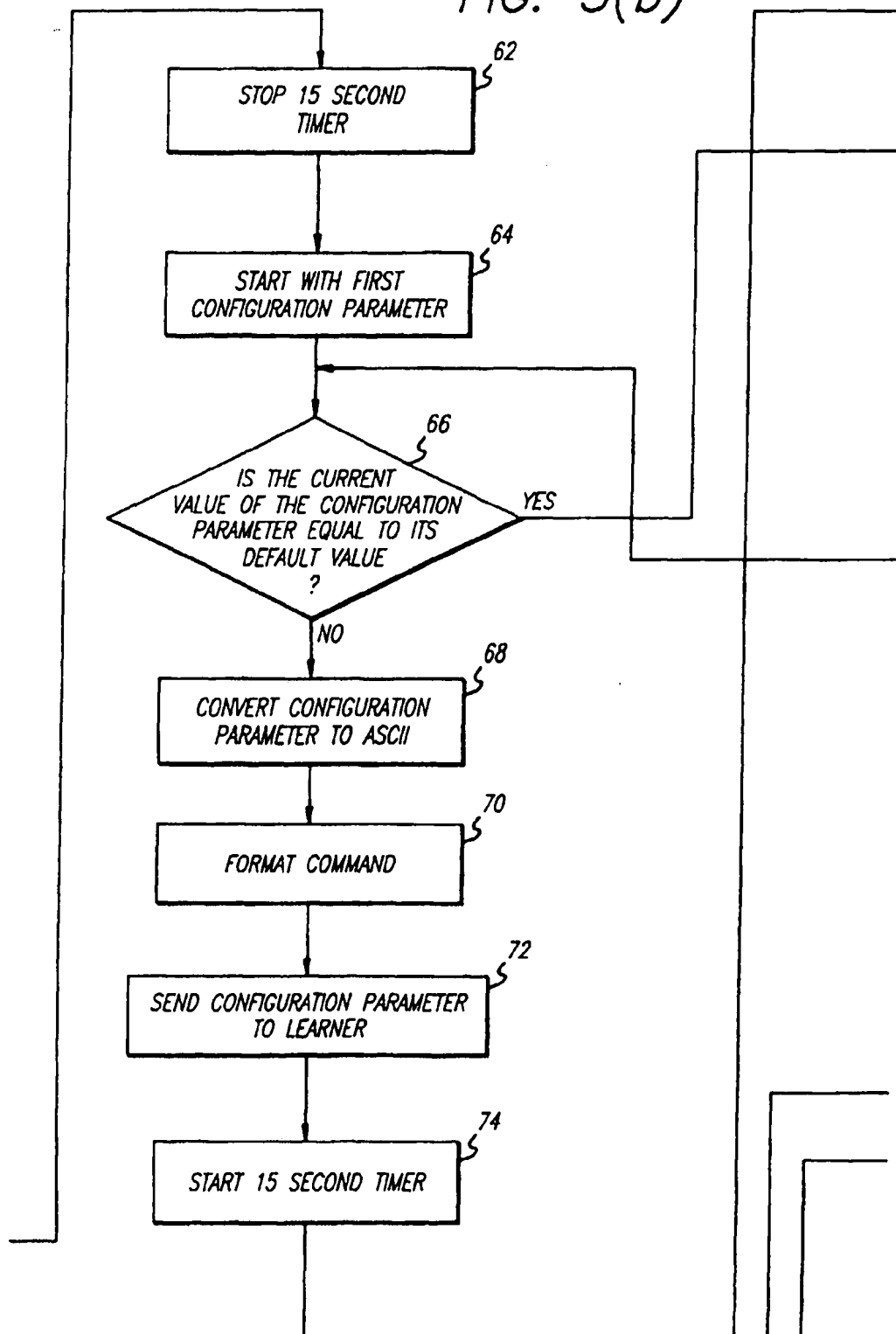
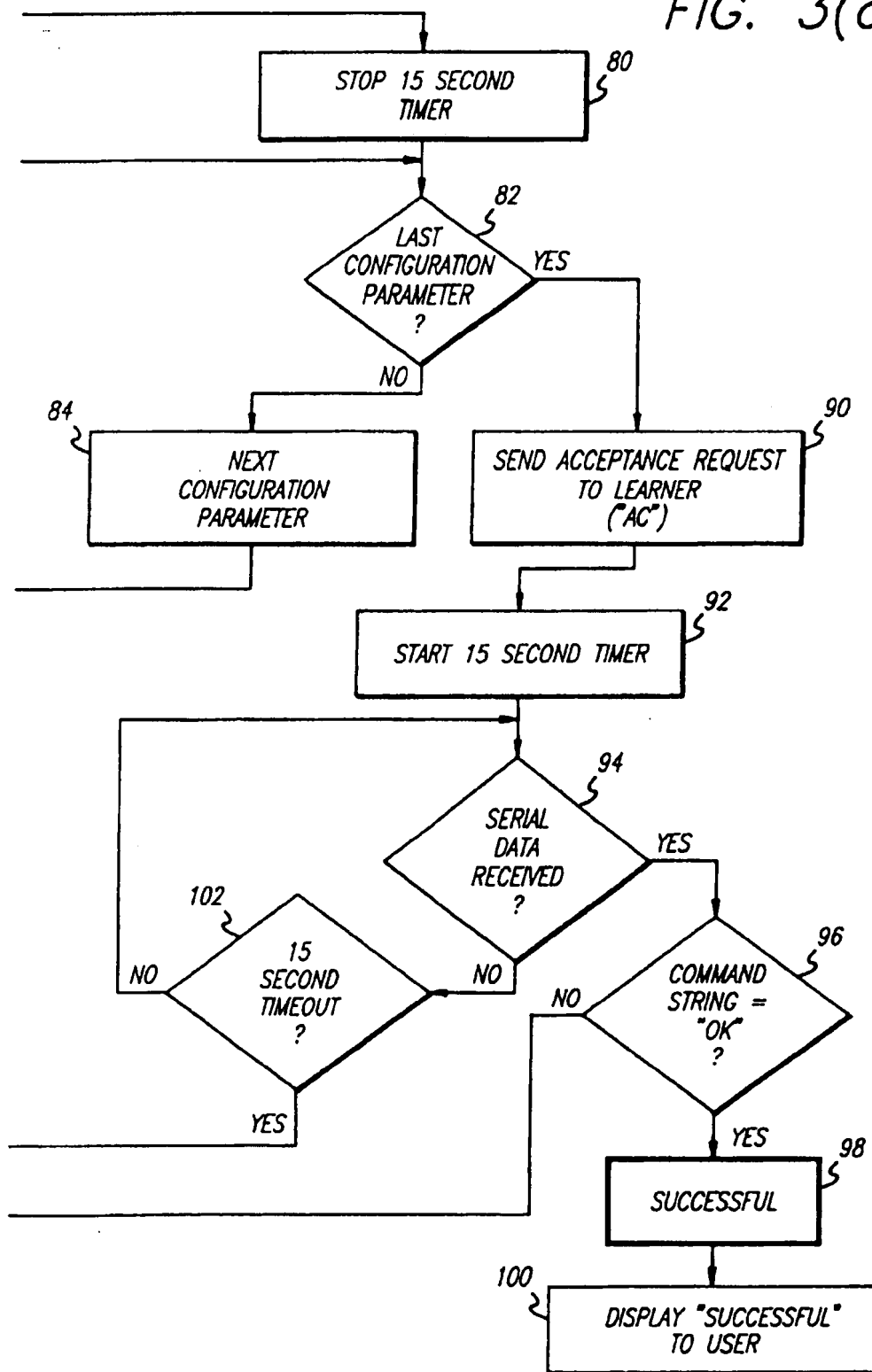


FIG. 3(c)



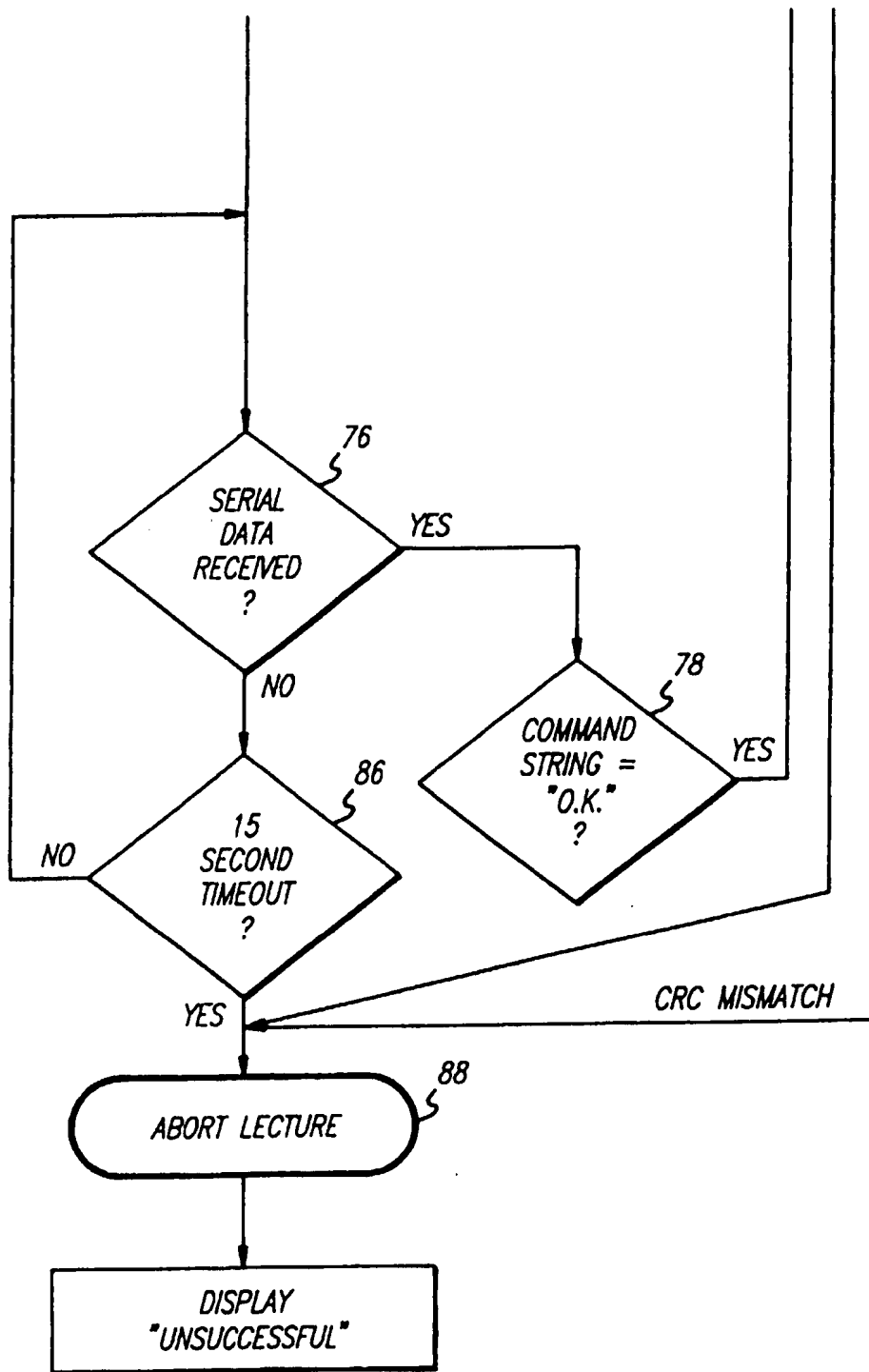
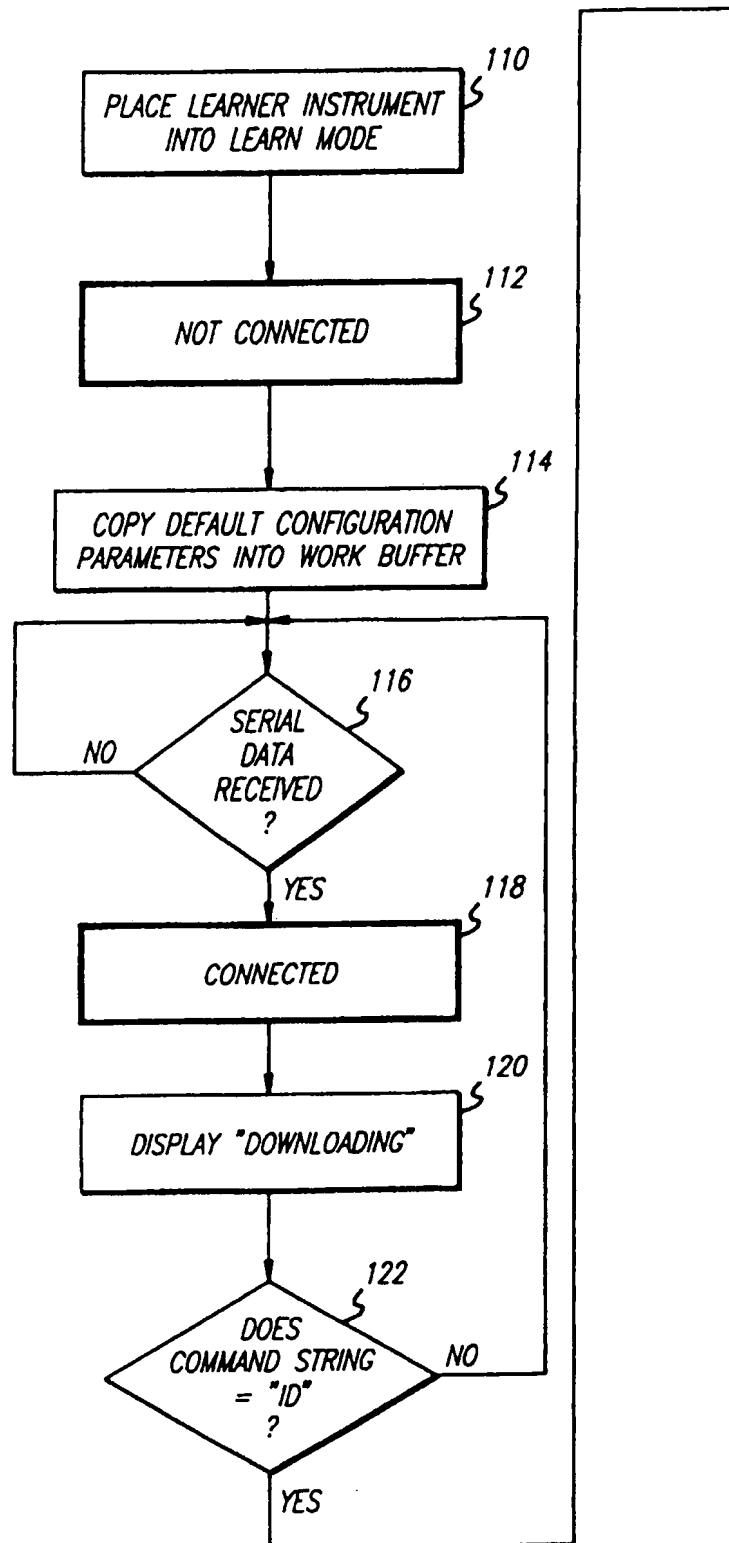


FIG. 3(d)

FIG. 4(a)



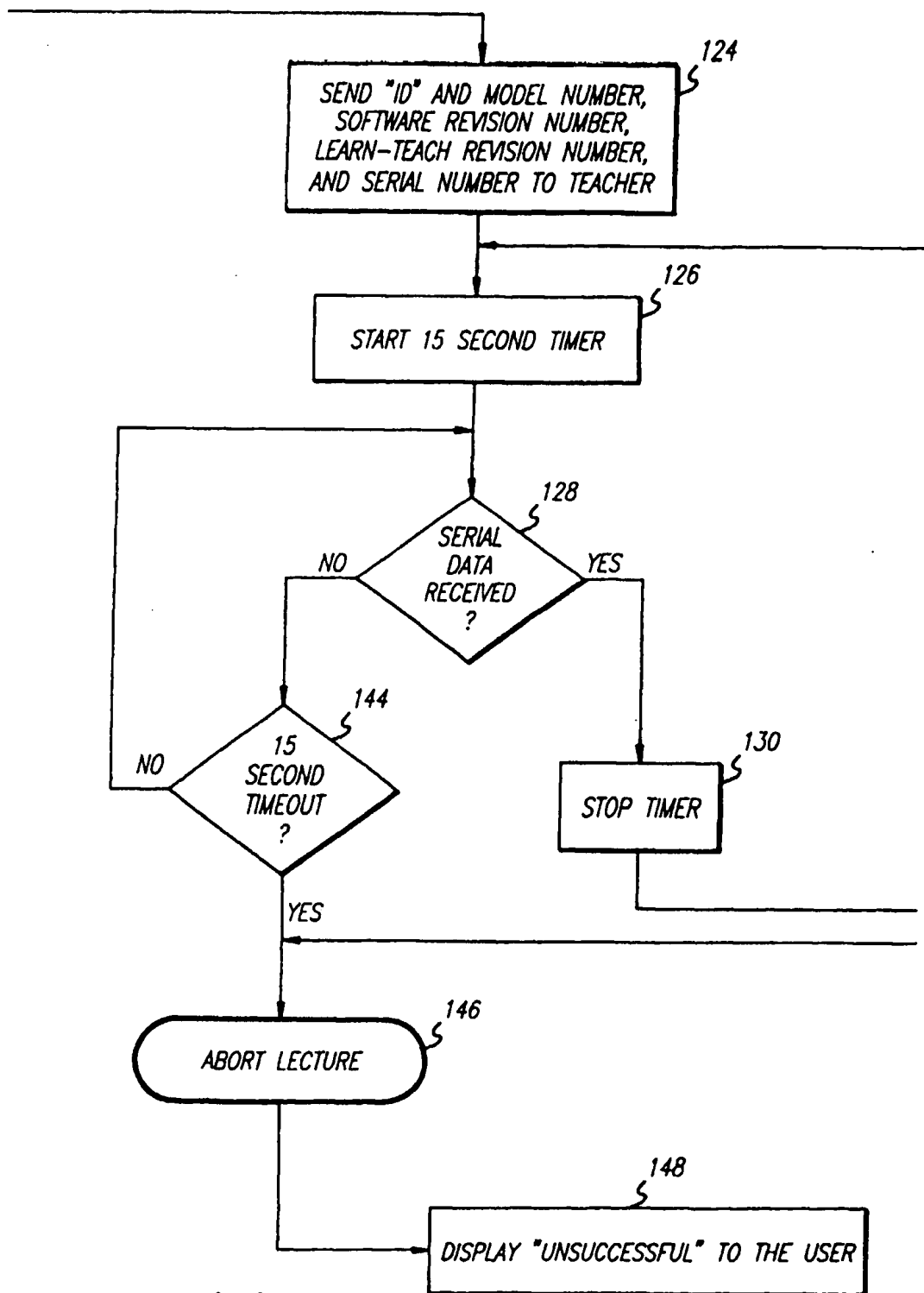
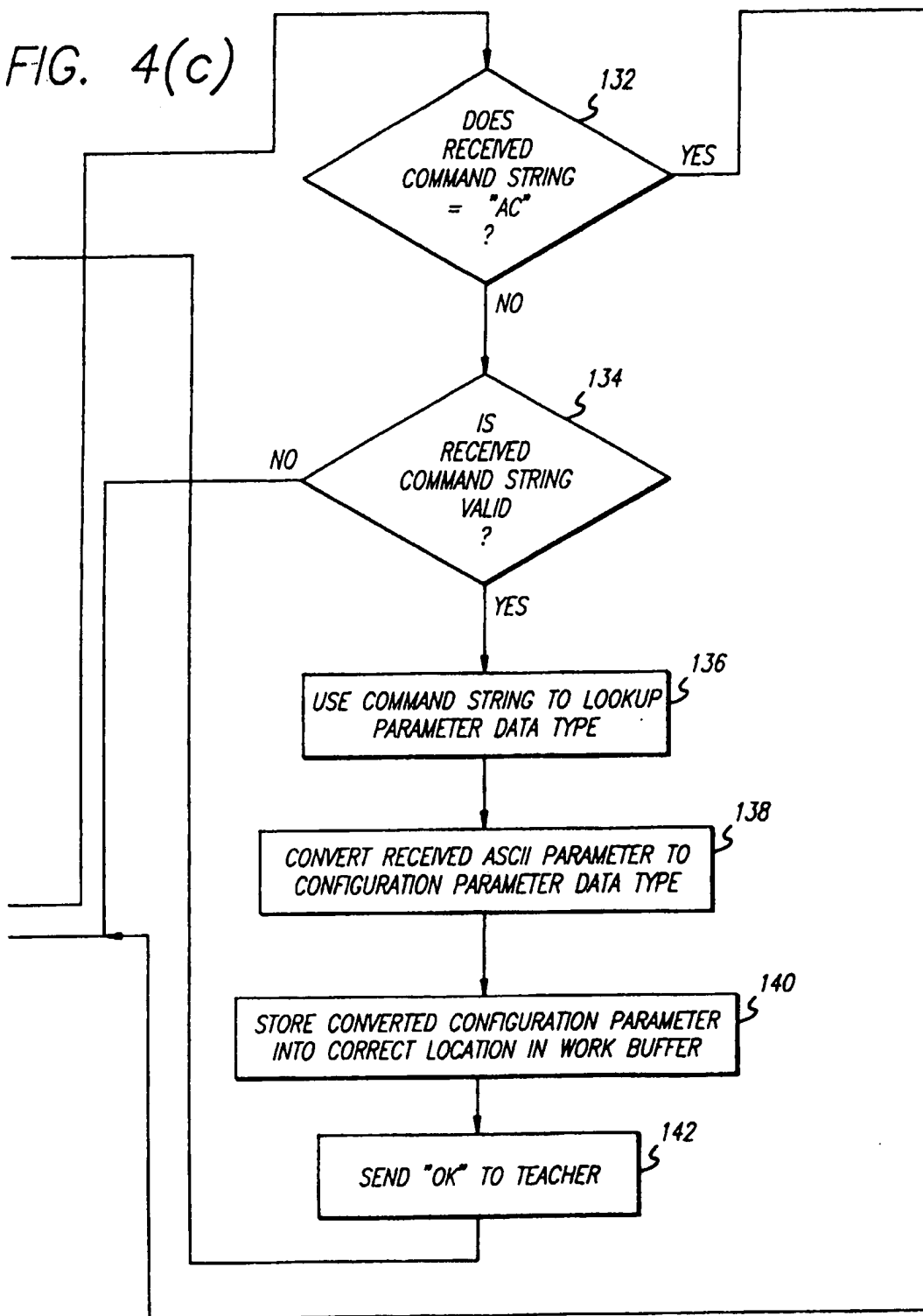
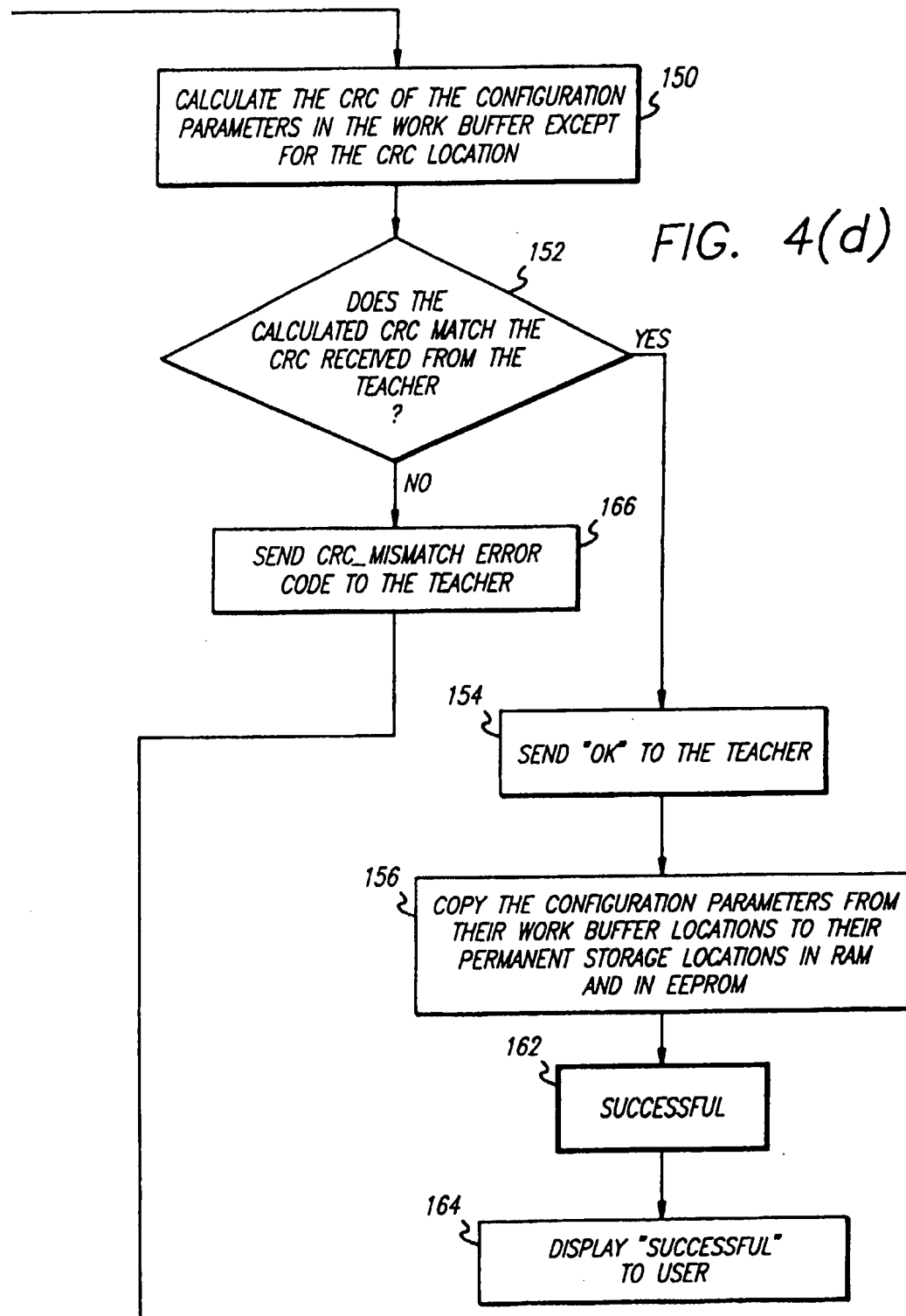


FIG. 4(b)

FIG. 4(c)





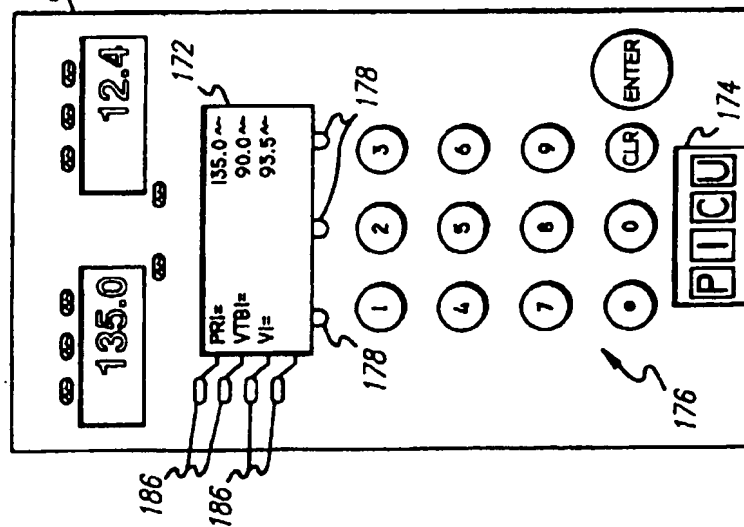


FIG. 5

FIG. 6A

FIG. 6B

FIG. 6C

FIG. 7A

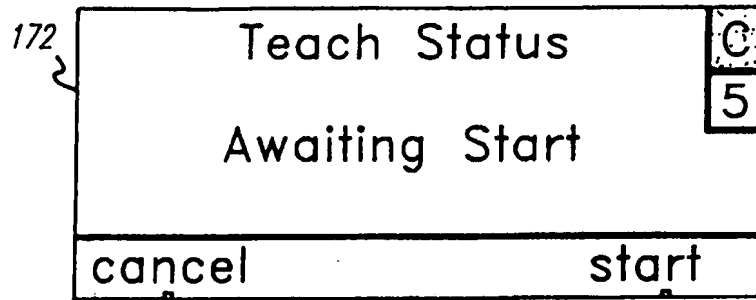


FIG. 7B

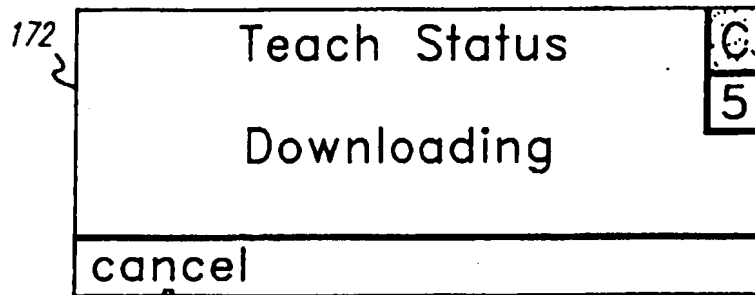


FIG. 7C

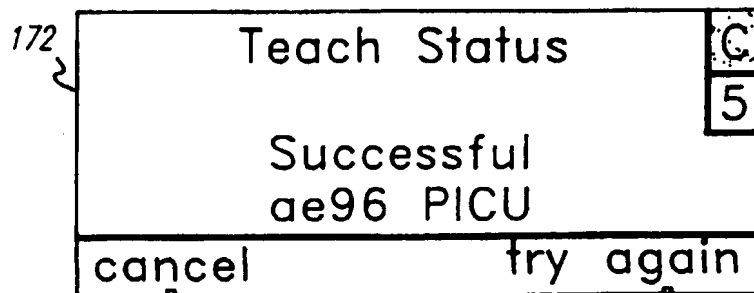


FIG. 7D

172 { Teach Status
Unsuccessful

cancel try again

FIG. 8A

172 { Learn Status
Awaiting Download

cancel

FIG. 8B

172 { Learn Status
Downloading

cancel

FIG. 8C

172 {

Learn Status		C
Successful ae96 PICU		5
cancel	try again	

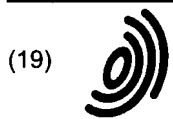
FIG. 8D

172 {

Learn Status		C
Unsuccessful		5
cancel	try again	

FIG. 9

Configuration has been changed. Press On/Off key to keep name PICU.		C
cancel	rename	



(19)

Europäisches Patentamt

European Patent Office

Office européen des brevets



(11)

EP 0 612 004 B2

(12)

NEW EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the opposition decision:

04.10.2000 Bulletin 2000/40

(51) Int. Cl.⁷: **G05B 19/042, A61M 5/172**

(45) Mention of the grant of the patent:

26.03.1997 Bulletin 1997/13

(21) Application number: **94100246.1**

(22) Date of filing: **10.01.1994**

(54) Configuration control system for configuring multiple biomedical devices

Konfigurierungssteuerungssystem zur Konfigurierung mehrerer biomedizinischen Vorrichtungen

Système de commande de configuration pour configurer des dispositifs biomédicaux multiples

(84) Designated Contracting States:
DE FR GB

(30) Priority: **15.01.1993 US 5249**

(43) Date of publication of application:
24.08.1994 Bulletin 1994/34

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Description

BACKGROUND

[0001] The invention relates generally to configuring biomedical devices, and more particularly, to a system for configuring multiple biomedical devices identically.

[0002] Configuration of a single biomedical device, such as an infusion pump, may take from several minutes to an hour, or longer, to accomplish. Configuration can involve setting the maximum infusion rate, setting the air-in-line alarm threshold level, setting the maximum pressure that can be applied by the pump, and other parameters. When several to hundreds of such biomedical devices must be configured, a significant amount of time is required by skilled personnel. Typically, a biotechnical engineer on the hospital staff or available from another source individually configures each of the biomedical devices as required. This can result in substantial personnel costs to the hospital as well as a substantial down time during which the pumps are undergoing reconfiguration and are unavailable for use.

[0003] In many cases, a large number of the same type of biomedical devices must be configured identically. For example, all infusion pumps in a neonatal ward may have the identical alarm threshold levels, identical maximum infusion rates, and other operational parameters. In the case where each of the infusion devices used in the ward must be configured individually, a substantial amount of time may be required before all pumps are available for use.

[0004] An additional consideration is determining what configuration any particular biomedical device has once it has been configured. In many cases, it is not apparent what that configuration is, nor is it easily determinable. An example for an infusion pump may be the rate range. A pump configured for a neonatal rate range of from 0.1 to 99.9 ml/hr would be unsuitable for use on an adult in an emergency requiring an infusion at a rate greater than 100 ml/hr. In many cases in pumps today, the configuration of the pump is not apparent unless the pump has been switched "on." And even when switched on in some such cases, the rate range is still not discernible by the operator in the normal operating mode of the device. The rate range limits can only be known from documentation that may be accompanying the device or by a service routine to be performed by a biotechnical engineer.

[0005] Infusion pumps, as well as other devices, are often kept in reserve in a "central supply" where they can be checked out for use as required. Many devices having different configurations may be shelved together in such a supply area. It is imperative that the device checked out have the configuration desired by the operator.

Additionally, in hospitals and other institutions, devices

may be loaned or passed from one area of the institution to another. Not being able to rapidly and accurately determine the configuration of the device can result in a slower transfer process. The operator receiving the device may be surprised by a different user interface or, worse, by different performance characteristics which may not suit the patient's needs. Another device must then be obtained with the commensurate loss of time. The constant display of a device's configuration would assist in obtaining devices from a central supply and in the transfer of devices between different hospital areas and would alert a potential user that a device needs reconfiguration before its next use.

[0006] In some prior biomedical devices, the configuration is only visible at the time the configuration process is performed. That is, the configuration name or identifier is displayed temporarily at the time the device is configured by the biotechnical engineer but is not thereafter available. Documents must be carried with the device to determine its configuration. In some other biomedical devices, the configuration is displayed only at initial power-on of the device. It is not available when the device is in a powered-off state. In another approach, the external cases of devices are made to look different, such as, given different colors. In another approach, the devices are given different model numbers for different configurations. Disadvantages to these approaches include that the device configuration cannot be easily changed by the customer and separate devices must be obtained for different applications.

[0007] In another prior approach, certain sets of configurations are pre-installed in the device, one of which can be selected through a menu offered as part of the maintenance routine of the device. The biotechnical engineer selects one of the configurations offered and the device automatically configures itself with the parameters corresponding to that selected configuration. However, custom configurations and configuration names are not available with such an approach and the configuration name is not apparent while the device is switched off.

[0008] Hence, those concerned with the use, configuration, and reconfiguration of a plurality of like biomedical devices, and particularly those concerned with such configuration aspects on devices having large numbers of configurable parameters, have recognized the need for an improved, relatively simple, economical, durable, and reliable system for more rapidly configuring such devices and for indicating the set configuration to users and potential users. The present invention fulfills these needs and others.

SUMMARY OF THE INVENTION

[0009] The present invention may in one aspect be summarized as an biomedical apparatus as claimed in claim 1.

[0010] It may in another aspect be summarized as a

method as claimed in claim 7.

[0011] Briefly, and in general terms, the present invention resides in a new and improved system for configuring a second biomedical device in the same configuration as a first device. In one aspect, the first device is configured with operational parameters as desired and then is connected through a communication link to the second device to be configured. After completing such connection, a teach mode is invoked in the first device and a learn mode invoked in the second device. Certain operational parameters set in the first device are then communicated to the second device which receives and accepts such configuration. The second device then becomes configured identically to the first device. The second device indicates acceptance of the configuration by indicating to the first device that the configuration control process is complete. Both the first and second devices indicate by means of respective displays that the reprogramming of the configuration of the second device is complete.

[0012] In another aspect in accordance with the invention, the first device compares each of its operational parameters to the default operational parameters of the second device and communicates only those parameters which differ. Increased speed in communications and less likelihood of error results from this feature.

[0013] Before any configuration data is communicated to the second device, the first device requires the second device to identify itself. The first device then compares the identification data received from the second device to acceptable identification data stored in the first device. If the identification data received from the second device does not agree with the identification data stored in the first device, the first device will not send configuration data to the second device but will instead provide a prompt to the operator indicating such status. In the event that the identification data of the second device is acceptable to the first device, the first device will communicate the configuration data to the second device and both devices will indicate a successful transfer of data.

[0014] In a further aspect in accordance with the invention, the configuration control system will issue a reminder prompt to the operator if the configuration of the device has been changed and the operator attempts to switch off the power to the device involved or send the new configuration to a second device without first assigning a configuration name. The operator may then assign a configuration name or may continue with the power-off operation or the teach operation in which case the prompt will be overridden and the present name assigned to this configuration. However, such a prompt will not be given in the case of a learn device which was just re-configured by a teach device.

[0015] The operator may assign a multi-character name to the configuration set in the first device, which may comprise letters or numbers or both, and which

becomes a part of the configuration. The first device will communicate this configuration name to the second device and that name will become part of the configuration of the second device as well as other downloaded parameters. In accordance with this latter feature, the operator is able to configure the device with custom configurations and is able to provide custom configuration names. As a result, more configurations and configuration names are available than with past systems and users can instantly determine the configuration of each device. Each configuration control system includes a continuously powered display mounted on the device for continually displaying that assigned multi-character configuration name, even during conditions of power-off.

[0016] The above and other advantages of the present invention will become apparent from the following detailed description of preferred embodiments when taken in conjunction with the accompanying drawings of an illustrative embodiment.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017]

FIG. 1 is a schematic diagram of the connection of first and second devices through a communications link in accordance with one aspect of the invention; FIG. 2 is a block diagram of a system for configuring a second device in accordance with a first device; FIG. 3 is a flow chart demonstrating a method in accordance with the principles of the invention in which a first device is set into a teach mode and transfers its configuration to a second device; FIG. 4 is a flow chart demonstrating a method in accordance with the principles of the invention in which a second device is set into a learn mode and receives its configuration from a first device; FIG. 5 is a sample front panel diagram of a device which may be used to transfer a configuration to a second device; FIGS. 6A, 6B, and 6C demonstrate front panel displays of configuration modes; FIGS. 7A through 7D are sample displays of the teach mode of a first device; FIGS. 8A through 8D are sample displays of the learn mode of a second device; and FIG. 9 is a sample display of a prompt given when a name is not assigned a new configuration.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0018] Referring now to the drawings with more particularity, wherein like reference numerals designate like or corresponding elements among the several views, there is shown in FIG. 1 a configuration control system 10 for configuring multiple biomedical devices. The con-

trol system 10 comprises in this illustration an input device 12 such as a keypad, a processor 14 which receives signals from the input device 12 and responds to them, a display 16 which presents information from the processor 14 to an operator, a memory 18 for storing data and programs, and a communications port 20 for establishing a communications link 22 with another device 24.

[0019] An application of the configuration control system discussed above is shown in FIG. 2. In this figure, a first infusion pump 26 is shown connected to a second infusion pump 28 through a communications link 22. Data is passed between them as will be described below in greater detail. The communications link in this case comprises a serial cable 22 connected between serial ports 30 and 32 of the first and second pumps respectively. The RS-232C standard is used in this embodiment. As also will be described below in more detail, each device 26 and 28 has a display 34 and 36 respectively which continuously indicates the configuration of the device, regardless of whether the device is powered or not powered. In the case of FIGS. 2, 5, 6A, 7C, 8C, and 9 the configuration name PICU (Pediatric Intensive Care Unit) is displayed.

[0020] Referring now to FIG. 3, a method embodying the principles of the invention is shown. A first device, designated the "teacher" is placed into the "teach" mode 44. The teacher then begins polling the communications link for a response from a second device. An identify request 46 is sent and a timer is started 48 which provides a fifteen-second period of time within which the teacher is to receive the identification. The teacher then waits 50 for the receipt of serial data. If no data is received within the fifteen seconds, a timeout occurs 52 and the identification request is again sent 46. In the event that serial data is received, the teacher considers itself to be connected 54 and it then displays a message indicating that data is being transferred 56. If the data received is an identification string 58, the teacher compares it to acceptable identifications 60 stored in the memory of the teacher device to verify that the second device is compatible with the teacher. The timer is then stopped 62.

[0021] The learn-teach feature is assigned its own configuration management version number, separate from the software version of the device. This allows devices which have different versions of software to transfer their configurations to one another as long as the configuration portions of the software have not been impacted by the change in software.

[0022] The teacher then starts with its first configuration parameter 64 and compares that configuration parameter to the corresponding default configuration parameter in the second device 66. In accordance with this embodiment, the teacher includes in its memory all default configuration parameters of compatible learner devices. The teacher thus compares its present configuration parameters to the default parameters stored in

its memory. If the parameters are unequal, the teacher device converts the parameter data to ASCII form 68, formats a command 70, and sends the configuration parameter to the second or learner device 72. A second timer is started 74 and the teacher device waits for a correct response from the learner device 76. If a response is received indicating that the command string was acceptable 78, the timer is stopped 80 and the teacher device determines if the last parameter was sent 82. If more parameters remain, the teacher device moves to the next parameter 84 and the process is repeated.

[0023] In the case where the current configuration parameter of the teacher unit equals the default parameter value 66, the teacher device does not send the parameter to the learner device but instead proceeds to determine if this was the last configuration parameter 82, and if not, moves to the next parameter 84 as discussed above. A result of this feature is that the teacher device only sends configuration parameters which differ from those already in the learner device.

[0024] After sending a configuration parameter, the timer is monitored 86 and if the fifteen second limit is met, the configuration control process is terminated 88 and a message displayed to the operator that the process was "unsuccessful." If the time limit has not been met, the teacher continues to wait for serial data 76 and the indication that the command string was acceptable 78.

[0025] In the event that the parameter was the last parameter 82, the teacher then sends an acceptance request 90 to the learner device, and a third timer is started 92. The teacher device then waits to receive serial data 94, for the command string indicating acceptance to be received 96 and then considers the configuration control to be successful 98. A "successful" display is then provided 100 to the operator.

[0026] Once confirmed, the configuration name is displayed in a special reflective LCD display on the front panel of the device. This display along with its driver require very little drive current and are thus suitable to be kept active regardless of the power status of the device.

[0027] If the timer times out 102 before receiving the acceptance signal or if the configuration is not acceptable to the learner 96 because of CRC mismatch error, for example, the teacher then terminates the configuration control process 88. Otherwise, the teacher continues to wait for serial data 94.

[0028] Turning now to the configuration control process of the second or learner device, reference to FIG. 4 is made. The learner device is placed into a learn mode 110 and as yet is considered to be in an unconnected state 112. The default configuration of the learner device is copied into its temporary working buffer 114 and the receipt of serial data is awaited 116. Upon receipt of serial data, the learner device is considered to be in a connected mode 118 and the device dis-

plays "downloading" to the operator.

[0029] Upon receiving the command string requesting identification 122, the learner device sends an ID command response which comprises identification data, such as its model number, its software revision number, its learn/teach revision number and its serial number to the teacher device 124. A timer is started 126 and the learner device waits for the receipt of serial data 128. Upon receiving serial data, the timer is stopped 130 and the received command string is reviewed to determine if it is a request for acceptance 132. If it is not such a request, the command string is evaluated for validity 134 by comparing it to a stored table of acceptable commands and determining that it is the correct data type. The command string is then used to look up the parameter data type (for example integer, float, etc.) 136 and is converted from ASCII to the configuration parameter data type 138. The configuration parameter is then stored in the temporary buffer 140 of the learner device and an OK indication sent to the teacher device. The learner device then starts the timer 126 and waits for the receipt of the next configuration parameter 128. If a timeout 144 is encountered before serial data is received, the configuration control process is terminated 146 and a display of "unsuccessful" provided to the operator 148.

[0030] When a request for acceptance is received from the teacher device 132, the learner device calculates the cyclic redundancy check (CRC) of the configuration parameters stored in the temporary work buffer, except for the CRC location, 150 and compares the calculated number with the CRC number received from the teacher device 152. If they match, the learner device sends an OK signal to the teacher device 154 and copies the buffer-stored parameters into permanent storage locations in RAM 156 and EEPROM. The EEPROM provides a configuration backup storage means for times when power to the device is completely removed. The learner device then displays "successful" to the operator 164.

[0031] However, if the CRC codes did not match 152, the learner device would send a CRC mismatch error signal to the teacher device 166 and then terminate the configuration transfer process 146 and display "unsuccessful" 148.

[0032] The use of error detection routines in serial communications is well known to those skilled in the art. In particular, cyclic redundancy checks (CRC) are well known and are often used. In the embodiments shown herein, a 16-bit CCITT CRC polynomial is used although others may function adequately. See J. Campbell, C Programmer's Guide to Serial Communications, Howard W. Sams & Company, 1987, pages. 66-68.

[0033] In one embodiment, data communications take the following ASCII form:

MA500.0

where "MA" in this case is a two character initial command string identifier for the maximum pressure limit

and "500.0" is the value to be transferred. Other identifiers are usable such as "KV" for the keep-vein-open rate. Each two-character identifier is followed by data having a fixed length for each identifier. That is, the length of data following the "MA" identifier may differ from the data length following the "KV" identifier. However, the length of data following each "MA" identifier is always the same, or fixed.

[0034] Turning now to FIG. 5, in which there is shown the front panel 170 of an infusion pump to which the configuration control apparatus and method of the invention may be applied. The front panel includes a main display 172 with which the operator of the configuration control system interacts. Shown in FIG. 5, the main display 172 is presenting operational parameter data; however, as will be discussed and shown in more detail below, the display 172 is also used to configure the learner devices.

[0035] The front panel 170 also includes a continuously powered configuration display 174, which in this case, presents four characters to identify the present configuration of the infusion pump. The letters "PICU" have been selected in this case and stand for pediatric intensive care unit; however, in accordance with one aspect of the invention, the operator may select any characters to indicate the configuration of the device. Also included with the front panel is a keypad 176 for the operator's use in entering data and issuing commands. In this embodiment, the pump includes "soft" keys which are available for the operator's use in sending commands to the processor. A first set of three soft keys 178 and a second set of four soft keys 186 are shown in FIG. 5; however, more or fewer may be included with the device as needed. These keys have the function as programmed by the current mode of the processor, as will be shown in reference to the following figures.

[0036] Referring now to FIG. 6A, the main display 172 is shown and is indicating that the processor is in the configuration mode. The serial number (ID No.) of the device is presented with the software revision number (SW Rev.) and the configuration identifier. In this case, the configuration identifier comprises eight characters. The first four characters are the computed CRC and the second four are the operator-assigned configuration name. The first four characters are automatically assigned by the processor as the CRC number corresponding to that configuration. The second four operator-assigned characters are assigned to the configuration, actually becoming a part of the configuration. The second set of four characters of the identifier would be the configuration name and could be, for example, the initials of the hospital area such as PICU (discussed above), ICU (intensive care unit) or OR1 (operating room 1), or others. The use of an error detection routine such as CRC combined with a configuration name result in it being very unlikely that two instruments which have the same identifier will not have the same configuration.

[0037] A continuation of the configuration menu can be obtained from the screen of FIG. 6A by pressing the "soft" key identified as "MORE" and indicated by the bar 180. As can be seen by reference to FIG. 5, this particular bar is placed over the right-most soft key 178. FIG. 6A also presents an organization technique in which each screen is given a unique code. In the screen of FIG. 6A, the code is placed in the upper right-hand corner and is "C1." This indicates that the screen is of the "C" series (in this case "C" representing the configuration menu) and is number "1" in that series. Pressing "MORE" at the right hand arrow moves to number "2" in the menu series.

[0038] FIG. 6B presents a second screen coded "C5" which indicates the learn and teach revision numbers. In accordance with one aspect of the invention, each device will include a revision code which will be checked by the teacher device to determine if the learn and teach programs of both devices are compatible. As also shown in FIG. 6B, a bar 182 has been used to establish a soft key entitled "MORE" over the center soft key 178 shown in FIG. 5 which will move the menu to page 4 of the configuration series if pressed. Other soft keys include "LEARN" and "TEACH" which may be pressed to enter the device into the learn or teach mode respectively.

[0039] Referring now to FIG. 6C, an example of how one configuration item might be set is presented. Configuration parameters for the air-in-line features of the device are presented on the main display 172. The upper right-hand corner indicates that this is a sub-screen of menu page 2 in the "C" series. Additional soft keys have been indicated along the vertical left edge of the display with two bars 184. As can be seen by reference to FIG. 5, these bars indicate the two lower soft keys 186. Pressing these soft keys 186 causes different choices to be selected on the display. For example, pressing the soft key 186 corresponding to the upper bar in FIG. 6C once will cause the number "200" to be highlighted and the number "100" to be de-emphasized. Confirming this selection can be accomplished by pressing the "confirm" soft key. This will cause 200 microliters to be the air-in-line alarm threshold volume.

[0040] In accordance with the configuration control process, a device which may be called the teacher device is manually configured to suit the particular needs of the hospital or area of a hospital or other institution. In the configuration mode of the device, items such as rate range, display language, air-in-line sensitivity, occlusion pressure limits, etc., are set as needed.

[0041] After the configuration of the teacher device has been completed, the device may now be switched into the teach mode by pressing the soft key to the left of the characters "Teach" as shown in FIG. 6B. FIG. 7A shows the device in the teach mode. The teach mode may be started by pressing the START soft key in the lower right-hand corner. In the case where the learn device has been properly connected and has the cor-

rect identification, the teach device will download parameter data and indicate this status as shown in FIG. 7B. Where all data was successfully downloaded and an identifier assigned, the teach device display will indicate this status as shown in FIG. 7C. However, where an error of some type occurred during configuration control of the learn device, the display of the teach device will indicate "unsuccessful" as shown in FIG. 7D.

[0042] As shown in FIG. 7C in the case of a successful configuration, a new learner device may be connected to the teacher device and the "try again" soft key pressed. This will repeat the above configuration process with the new device. This may be repeated until all learner devices have been configured as the teacher device.

[0043] Similar screen displays are presented by the learn device during configuration control as is shown in FIGS. 8A through 8D. In FIG. 8A, the learn device has been placed into the learn mode and is awaiting the download of data from the teach device. When data is being downloaded, the display indicates such status as shown in FIG. 8B. When the configuration control was successful, i.e., all parameters were successfully transferred, a display similar to FIG. 8C is presented to the operator. However, when an error arose during data transfer or identification, a display similar to FIG. 8D is presented to the operator. Thus, displays on both devices provide real-time status of the transfer and, if successful, the second device displays the configuration name and the CRC of its new configuration.

[0044] FIG. 9 demonstrates a display presented to the operator which serves as a reminder prompt that a configuration change has been made while no configuration name change has been received by the processor. In some embodiments, an audible prompt may be given as well. This feature gives the operator a chance to rename the new configuration, or retain the same name for a new configuration. Pressing the on/off key will assign that same name (PICU in this case) to the new configuration. On the other hand, the operator may assign a new name by pressing the "rename" soft key. Without this feature, the operator may have inadvertently saved the new configuration under the PICU name thus possibly having a mix of configurations with the same name. The questioning process by this feature alerts the operator of this possibility.

[0045] It should be appreciated that the use of infusion pumps above was for illustration purposes only. The invention is not meant to be limited to infusion pumps but may have application to other devices. Additionally, instead of connecting the learn/teach devices together with a physical cable, a wireless link such as an infrared link could be used. The first device and second device could be placed next to each other and communicate with each other through the use of light-emitting and light-sensing diodes contained in each device. This would be convenient for the operator in that a cable would not have to be stored, found, and then connected

between the two. Additionally, the possibility of losing the cable would not be a concern with an infrared link. A possible disadvantage is that the cost of the device may be increased due to the cost of the infrared components.

[0046] In a further improvement, parallel communications may be used rather than serial communications. Also, other types of displays for displaying the configuration name may be used as long as they do not exceed the cost and power limits of the device. The number of characters selectable for a configuration name could be increased and is constrained only by the cost of displaying them to the user. Additionally, removable storage media in the device may be programmed for proper configuration either by an accessory custom device, a personal computer or other device. Furthermore, the teach device need not be manually configured. The keypad need not be used for the initial configuration; its configuration may be set by connecting the device to a computer which then would download the configuration from a database of predetermined configurations generated off-line.

[0047] Although the invention has been described and illustrated in the context of a teacher device connecting to and teaching a single learner device, the principles of the invention may apply to the arrangement where a single teacher device is connected to a plurality of learner devices simultaneously, such as through a network. The teacher may adjust its timing and routines to wait until all learners have identified themselves and have responded to each teacher command.

[0048] The concept that a device without the help of any external or custom devices can communicate its configuration to another device of like type can provide significant time savings in configuring multiple devices and provides a significant advantage to users. The configuration control system of the present invention satisfies a long-existing need for an improved, relatively simple, economical, and reliable system for configuring multiple devices identically. Additionally, the system of the invention tends to ensure against mistaken use of inappropriately configured devices.

Claims

1. Biomedical apparatus for controlling a plurality of independently programmable and independently operable biomedical devices, each biomedical device having an identical set of configuration parameters for controlling its operation, each configuration parameter having a range of user-selectable values, to have the same configuration so that the biomedical devices may operate independently of each other with the same configuration, the apparatus comprising:

a first switch included in each of the biomedical devices which when activated, provides a

teach mode signal;

a second switch included in each of the biomedical devices which when activated, provides a learn mode signal;

an input device included in each of the biomedical devices that selects configuration parameters of the biomedical device;

a disconnectable communications link connected between two of the plurality of the independently operable biomedical devices that communicates configuration parameters between the two whereby the link may be disconnected from the two biomedical devices so that the biomedical devices may operate independently of each other;

a processor included in each of the biomedical devices that is responsive to the teach mode signal to provide a configuration signal representative of at least one of its user-selected configuration parameter values to the communications link and is responsive to the learn mode signal to receive configuration signals through the communications link that cause the biomedical device in the learn mode to be configured identically with the biomedical device in the teach mode, and to provide a signal through the communications link indicating that the configuration of the independently operable biomedical device is complete and is responsive to character selection signals received from the input device to assign a configuration name to the current set of configuration parameter values, and provides said configuration name to the biomedical device in the learn mode; and

a display disposed on each of the plurality of biomedical devices responsive to the configuration complete signal indicating that the configuration of a biomedical device is complete.

2. The biomedical apparatus of claim 1 wherein each biomedical device further comprises a memory in which is stored default configuration parameter values of the other biomedical devices of the plurality, wherein

each processor responsive to the teach mode signal compares each of its own configuration parameter values against the stored default configuration parameter values of another biomedical device to which it is connected and the processor of which is responsive to the learn mode signal; and

the processor responsive to the teach mode signal provides only the configuration parameter values to the processor responsive to the learn mode signal which differ from the stored default configuration parameter values of the

- other biomedical device, said processor responsive to the teach mode signal downloading the configuration parameter values to the processor responsive to the learn mode signal only after receiving a predetermined signal from the processor responsive to the learn mode signal.
3. The biomedical apparatus of claim 2 wherein:
- each biomedical device further comprises a permanent memory, a non-volatile memory, and a working memory;
- each processor stores the configuration parameter values received from the other processor in the working memory; and
- upon providing the configuration complete signal, the other processor stores the configuration parameter values from the working memory into both the permanent memory and the non-volatile memory.
4. The biomedical apparatus of any of the preceding claims wherein each biomedical device further comprises a memory in which the respective processor stores that name with the current set of configuration parameter values wherein the processor downloads the name to the communications link with the downloaded configuration parameter values.
5. The biomedical apparatus of claim 4 wherein:
- the name comprises four alpha-numeric characters which may be selected by the operator; and wherein there is further a display which continuously displays the name regardless of whether the first biomedical device is powered on or off, said display comprising a four character display requiring relatively little drive current located on the front panel of the first biomedical device and continuously displaying the configuration name.
6. The biomedical apparatus of claim 5 wherein each of the biomedical devices:
- further comprises a name detector which detects if a new configuration has been stored in the respective biomedical device;
- determines if the operator has applied a new name to the current configuration;
- detects if a predetermined switch has been engaged; and if so provides a prompt to the operator that a new configuration name has not yet been stored for the new configuration, said name detector deactivating the prompt in the event that the user again engages the pre-
- terminated switch after the name prompt has been given.
7. A method for controlling a plurality of independently programmable and independently operable biomedical devices, each biomedical device having an identical set of configuration parameters for controlling its operation, each configuration parameter having a range of user-selectable values, to have the same configuration, each biomedical device having a teach and a learn mode, comprising the steps of:
- setting a first of said biomedical devices into a configuration mode;
- configuring the first biomedical device with a plurality of user-selected values of configuration parameters;
- connecting a disconnectable communications link between the first biomedical device and a second biomedical device of the plurality of biomedical devices for communicating configuration data between the two biomedical devices;
- setting the first biomedical device into the teach mode in which mode a processor included in the biomedical device provides configuration parameters representative of the user-selected values of the configuration parameters of the biomedical device;
- setting the second biomedical device into the learn mode in which mode the processor included in the biomedical device receives the user-selected values of the configuration parameters of the biomedical device in the teach mode to configure the biomedical device in the learn mode in accordance with those received user-selected values of the configuration parameters;
- assigning a user-selected configuration name to the current set of user-selected values of the configuration parameters of the biomedical device in the teach mode;
- storing that assigned configuration name and associating the user-selected values of the configuration parameters with it;
- transmitting selected values of configuration parameters of the first biomedical device to the second independently operable biomedical device over the communications link;
- accepting the selected values of the configuration parameters and the configuration name of the first biomedical device received by the second biomedical device over the communications link and configuring the second biomedical device according to those selected values of the configuration parameters received from the first biomedical device so that the second independently operable bio-

- medical device has the same configuration and configuration name as the first independently operable biomedical device;
- indicating on a display at the first and second biomedical devices that the configuration control process was successful; and
- disconnecting the communications link between the first biomedical device and the second biomedical device so that the first and second biomedical devices may operate independently of each other with the same configurations.
8. The method of claim 7 wherein the step of transmitting the selected values of the configuration parameters by the first biomedical device comprises the step of transmitting only the configuration parameter values to the second biomedical device which differ from the corresponding configuration parameter values in the second biomedical device and wherein the method further comprises the step of downloading first biomedical device configuration parameter values to the second biomedical device only after receiving a predetermined identification signal from the second biomedical device.
9. The method of claim 7 or 8 wherein:
- the step of transmitting the selected values of the configuration parameters comprises the step of storing in a memory default configuration parameter values of the other biomedical devices;
- comparing each of the first biomedical device configuration parameter values against the default configuration parameter values stored in said memory; and
- transmitting only the first biomedical device configuration parameter values to the second processor which differ from the stored default configuration parameter values.
10. The method of claims 7 through 9 wherein the step of configuring the second biomedical device comprises storing the configuration parameter values received from the first biomedical device in a working memory in the second biomedical device; and
- storing the configuration parameter values stored in the working memory in a permanent memory and a non-volatile memory in the second biomedical device.
11. The method of any of claims 7 through 10 wherein the step of assigning a user selected configuration name comprises:
- assigning four alpha-numeric characters as the configuration name; and
- continuously displaying the configuration name when power is on and off, wherein the step of displaying comprises displaying the configuration name on a four character display located on the front panel of the biomedical device and continuously displaying the configuration name.
12. The method of any of claims 7 through 11 further comprising the steps of:
- detecting if a new configuration has been stored in the respective biomedical device;
- determining if a new configuration name has been stored which applies to the currently stored configuration;
- providing a prompt if a predetermined switch has been engaged but a new configuration name has not yet been stored for the new configuration; and
- deactivating the prompt in the event that the predetermined switch is again engaged after the name prompt has been given.
13. The method any of claims 7 through 12 further comprising the step of providing a prompt if the power-off switch has been engaged or the step of setting the first biomedical device into the teach mode has been attempted without first storing a new configuration name for the new configuration.

Patentansprüche

1. Biomedizinische Vorrichtung zur Steuerung einer Mehrzahl unabhängig programmierbarer und unabhängig funktionsfähiger biomedizinischer Vorrichtungen, wobei jede biomedizinische Vorrichtung eine identische Menge von Konfigurationsparametern zur Steuerung der Betriebsweise der entsprechenden Vorrichtung aufweist, wobei jeder Konfigurationsparameter einen Bereich von dem Benutzer auswählbarer Werte aufweist, um die gleiche Konfiguration vorzusehen, so daß die biomedizinischen Vorrichtungen unabhängig voneinander mit der gleichen Konfiguration betrieben werden können, wobei die Vorrichtung folgendes umfaßt:
- einen ersten Schalter, der in jeder der biomedizinischen Vorrichtungen vorhanden ist, und der, wenn er aktiviert wird, ein Lehrmodussignal vorsieht;
- einen zweiten Schalter, der in jeder der biomedizinischen Vorrichtungen vorhanden ist, und der, wenn er aktiviert wird, ein Lernmodussignal vorsieht;
- eine Eingabevorrichtung, die in jeder der biomedizinischen Vorrichtungen vorhanden ist,

- und die die Konfigurationsparameter der biomedizinischen Vorrichtung auswählt;
einen trennbaren Übermittlungsabschnitt zwischen zwei Vorrichtungen der Mehrzahl unabhängig funktionsfähiger biomedizinischer Vorrichtungen, wobei dieser Übermittlungsabschnitt Konfigurationsparameter zwischen den beiden biomedizinischen Vorrichtungen übermittelt, wobei der Übermittlungsabschnitt von den beiden biomedizinischen Vorrichtungen getrennt werden kann, so daß die biomedizinischen Vorrichtungen unabhängig voneinander betrieben werden können;
einen Prozessor, der in jeder der biomedizinischen Vorrichtungen vorhanden ist, und der auf das Lehrmodussignal so anspricht, daß er ein Konfigurationssignal an den Übermittlungsabschnitt vorsieht, wobei dieses Signal mindestens einen der von dem Benutzer ausgewählten Konfigurationsparameterwerte darstellt, und wobei der Prozessor auf das Lehrmodussignal so anspricht, daß er Konfigurationssignale über den Übermittlungsabschnitt empfängt, wobei diese Signale bewirken, daß die biomedizinische Vorrichtung in dem Lernmodus genauso konfiguriert wird wie die biomedizinische Vorrichtung in dem Lehrmodus, und wobei der Prozessor über den Übermittlungsabschnitt ein Signal vorsieht, das anzeigt, daß die Konfiguration der unabhängig funktionsfähigen Vorrichtung vollständig ist, und wobei der Prozessor auf von der Eingabevorrichtung empfangene Zeichenauswahlsignale so anspricht, daß er der aktuellen Menge von Konfigurationsparameterwerten einen Konfigurationsnamen zuweist, und wobei der Prozessor den genannten Konfigurationsnamen der Vorrichtung in dem Lernmodus zuführt; und
eine Anzeige, die sich an jeder biomedizinischen Vorrichtung der Mehrzahl von biomedizinischen Vorrichtungen befindet, wobei die Anzeige auf das Konfigurations-Vollständigkeitssignal anspricht und anzeigt, daß die Konfiguration einer biomedizinischen Vorrichtung vollständig ist.
2. Biomedizinische Vorrichtung nach Anspruch 1, wobei jede biomedizinische Vorrichtung ferner einen Speicher umfaßt, in dem Ausgangswerte der Konfigurationsparameter der anderen biomedizinischen Vorrichtungen der Mehrzahl von Vorrichtungen gespeichert sind, wobei
- jeder auf das Lehrmodussignal ansprechende Prozessor alle eigenen Konfigurationsparameterwerte mit den gespeicherten Ausgangswerten der Konfigurationsparameter einer anderen biomedizinischen Vorrichtung vergleicht, mit der er verbunden ist, und des Prozessors, der auf das Lehrmodussignal anspricht; und wobei der auf das Lehrmodussignal ansprechende Prozessor dem auf das Lehrmodussignal ansprechenden Prozessor nur die Konfigurationsparameterwerte zuführt, die sich von den gespeicherten Ausgangswerten der Konfigurationsparameter der anderen biomedizinischen Vorrichtung unterscheiden, wobei der genannte auf das Lehrmodussignal ansprechende Prozessor die Konfigurationsparameterwerte erst dann auf den auf das Lehrmodussignal ansprechenden Prozessor herunterlädt, nach dem er ein vorbestimmtes Signal von dem auf das Lehrmodussignal ansprechenden Prozessor empfangen hat.
3. Biomedizinische Vorrichtung nach Anspruch 2, wobei:
- jede biomedizinische Vorrichtung ferner einen Langzeitspeicher, einen nichtflüchtigen Speicher und einen Arbeitsspeicher umfaßt;
jeder Prozessor die von dem anderen Prozessor empfangenen Konfigurationsparameterwerte in dem Arbeitsspeicher speichert; und
wobei der andere Prozessor nach der Bereitstellung des Konfigurations-Vollständigkeitssignals die Konfigurationsparameterwerte aus dem Arbeitsspeicher in dem Langzeitspeicher und in dem nichtflüchtigen Speicher speichert.
4. Biomedizinische Vorrichtung nach einem der vorstehenden Ansprüche, wobei jede biomedizinische Vorrichtung ferner einen Speicher umfaßt, in dem der entsprechende Prozessor den Namen mit der aktuellen Menge von Konfigurationsparameterwerten speichert, wobei der Prozessor den Namen in Verbindung mit den heruntergeladenen Konfigurationsparameterwerten in den Übermittlungsabschnitt herunterlädt.
5. Biomedizinische Vorrichtung nach Anspruch 4, wobei:
- der Name vier alphanumerische Zeichen umfaßt, die von dem Benutzer ausgewählt werden können; und wobei eine weitere Anzeige vorgesehen ist, die den Namen immer anzeigt, und zwar unabhängig davon, ob die erste biomedizinische Vorrichtung ein- oder ausgeschaltet ist, wobei die genannte Anzeige eine vierstellige Anzeige aufweist, für die nur eine geringe Antriebsstrommenge an dem Bedienungsfeld der ersten biomedizinischen Vorrichtung erforderlich ist, und wobei diese

Anzeige den Konfigurationsnamen ununterbrochen anzeigt.

6. Biomedizinische Vorrichtung nach Anspruch 5, wobei jede der biomedizinischen Vorrichtungen: 5

ferner einen Namendetektor umfaßt, der feststellt, wenn eine neue Konfiguration in der entsprechenden biomedizinischen Vorrichtung gespeichert worden ist; 10
feststellt, wenn der Benutzer der aktuellen Konfiguration einen neuen Namen zugewiesen hat; feststellt, ob ein vorbestimmter Schalter betätigt worden ist; und wenn dies der Fall ist, dem Benutzer ein Anforderungszeichen 15
zuführt, daß ein neuer Konfigurationsname für die neue Konfiguration noch nicht gespeichert worden ist, wobei der genannte Namendetektor das Anforderungszeichen dann deaktiviert, wenn der Benutzer den vorbestimmten Schalter 20
erneut betätigt, nachdem das Namensanforderungszeichen vorgesehen worden ist.

7. Verfahren zur Steuerung einer Mehrzahl unabhängig programmierbarer und unabhängig funktionsfähiger biomedizinischer Vorrichtungen, wobei jede biomedizinische Vorrichtung eine identische Menge von Konfigurationsparametern zur Steuerung der Betriebsweise der entsprechenden biomedizinischen Vorrichtung aufweist, wobei jeder Konfigurationsparameter einen Bereich von dem Benutzer 30
auswählbarer Werte aufweist, um die gleiche Konfiguration vorzusehen, wobei jede biomedizinische Vorrichtung einen Lehr- und 35

einen Lernmodus aufweist, wobei das Verfahren die folgenden Schritte umfaßt:
Einstellen einer ersten der genannten biomedizinischen Vorrichtungen in einen Konfigurationsmodus; 40
Konfigurieren der ersten biomedizinischen Vorrichtung mit einer Mehrzahl durch den Benutzer ausgewählter Konfigurationsparameterwerte;
Zwischenschalten eines trennbaren Übermittlungsabschnittes zwischen die erste biomedizinische Vorrichtung und eine zweite biomedizinische Vorrichtung der Mehrzahl von 45
Vorrichtungen, um Konfigurationsdaten zwischen den beiden biomedizinischen Vorrichtungen zu übermitteln;
Einstellen der ersten biomedizinischen Vorrichtung in den Lehrmodus, wobei ein in der biomedizinischen Vorrichtung vorhandener Prozessor in diesem Modus Konfigurationsparameter vorsieht, die die durch den Benutzer 50
ausgewählten Werte der Konfigurationsparameter der biomedizinischen Vorrichtung dar-

stellen;

Einstellen der zweiten biomedizinischen Vorrichtung in den Lernmodus, wobei der in der biomedizinischen Vorrichtung vorhandene Prozessor in diesem Modus die von dem Benutzer ausgewählten Konfigurationsparameterwerte der biomedizinischen Vorrichtung in dem Lehrmodus empfängt, um die biomedizinische Vorrichtung in dem Lernmodus gemäß diesen empfangenen, von dem Benutzer ausgewählten Konfigurationsparameterwerten zu konfigurieren;

Zuweisen eines von dem Benutzer ausgewählten Konfigurationsnamens in bezug auf die aktuelle Menge von durch den Benutzer ausgewählten Konfigurationsparameterwerten der biomedizinischen Vorrichtung in dem Lehrmodus;

Speichern des zugewiesenen Konfigurationsnamens und Zuordnung der von dem Benutzer ausgewählten Konfigurationsparameterwerte; Übermitteln ausgewählter Konfigurationsparameterwerte der ersten biomedizinischen Vorrichtung an die zweite unabhängig funktionsfähige biomedizinische Vorrichtung über den Übermittlungsabschnitt;

Annahme der ausgewählten Konfigurationsparameterwerte und des von der zweiten biomedizinischen Vorrichtung über den Übermittlungsabschnitt angenommenen Konfigurationsnamens der ersten biomedizinischen Vorrichtung, und Konfigurieren der zweiten biomedizinischen Vorrichtung gemäß diesen ausgewählten, von der ersten biomedizinischen Vorrichtung empfangenen Konfigurationsparameterwerten, so daß die zweite unabhängig funktionsfähige biomedizinische Vorrichtung die gleiche Konfiguration und den gleichen Konfigurationsnamen wie die erste unabhängig funktionsfähige biomedizinische Vorrichtung aufweist;

Anzeigen des erfolgreichen Konfigurationssteuerungsprozesses auf einer Anzeige an der ersten und der zweiten biomedizinischen Vorrichtung; und

Trennen des Übermittlungsabschnittes zwischen der ersten biomedizinischen Vorrichtung und der zweiten biomedizinischen Vorrichtung, so daß die erste und die zweite biomedizinische Vorrichtung mit den gleichen Konfigurationen unabhängig voneinander funktionsfähig sind.

8. Verfahren nach Anspruch 7, wobei der Schritt der Übermittlung der ausgewählten Konfigurationsparameterwerte durch die erste biomedizinische Vorrichtung den Schritt der Übermittlung nur der Konfigurationsparameterwerte an die zweite bio-

medizinische Vorrichtung umfaßt, die sich von den entsprechenden Konfigurationsparametern in der zweiten biomedizinischen Vorrichtung unterscheiden, und wobei das Verfahren ferner den Schritt umfaßt, in dem die Konfigurationsparameterwerte der ersten biomedizinischen Vorrichtung erst nach dem Empfang eines vorbestimmten Identifikationssignals von der zweiten biomedizinischen Vorrichtung heruntergeladen werden.

9. Verfahren nach Anspruch 7 oder 8, wobei:

der Schritt der Übermittlung der ausgewählten Konfigurationsparameterwerte den Schritt des Speichers von Ausgangswerten der Konfigurationsparameter der anderen biomedizinischen Vorrichtungen in einem Speicher umfaßt; wobei

alle Konfigurationsparameterwerte der ersten biomedizinischen Vorrichtung mit den in dem genannten Speicher gespeicherten Ausgangswerten der Konfigurationsparameter verglichen werden; und wobei

nur die Konfigurationsparameterwerte der ersten biomedizinischen Vorrichtung zu dem zweiten Prozessor übermittelt werden, die sich von den gespeicherten Ausgangswerten der Konfigurationsparameter unterscheiden.

10. Verfahren nach einem der Ansprüche 7 bis 9, wobei der Schritt der Konfiguration der zweiten biomedizinischen Vorrichtung das Speichern der von der ersten biomedizinischen Vorrichtung empfangenen Konfigurationsparameterwerte in einem Arbeitsspeicher in der zweiten biomedizinischen Vorrichtung umfaßt; und wobei

die in dem Arbeitsspeicher gespeicherten Konfigurationsparameterwerte in einem Langzeitspeicher und in einem nichtflüchtigen Speicher in der zweiten biomedizinischen Vorrichtung gespeichert werden.

11. Verfahren nach einem der Ansprüche 7 bis 10, wobei der Schritt der Zuweisung eines von dem Benutzer ausgewählten Konfigurationsnamens folgendes umfaßt:

Zuweisen von vier alphanumerischen Zeichen als Konfigurationsname; und

ununterbrochenes Anzeigen des Konfigurationsnamens sowohl im eingeschalteten als auch im ausgeschalteten Zustand, wobei der Schritt des Anzeigens des Konfigurationsnamens auf einer vierstelligen Anzeige umfaßt, die sich an dem Bedienungsfeld der biomedizinischen Vorrichtung befindet, und wobei die Anzeige den Konfigurationsna-

men ununterbrochen anzeigt.

12. Verfahren nach einem der Ansprüche 7 bis 11, wobei das Verfahren ferner die folgenden Schritte umfaßt:

Feststellen, ob eine neue Konfiguration in der entsprechenden biomedizinischen Vorrichtung gespeichert worden ist;

Feststellen, ob ein neuer Konfigurationsname gespeichert worden ist, der auf die aktuell bzw. gegenwärtig gespeicherte Konfiguration zutrifft;

Erzeugen eines Anforderungszeichens, wenn ein vorbestimmter Schalter aktiviert worden ist, während noch kein neuer Konfigurationsname für die neue Konfiguration gespeichert worden ist; und Deaktivieren des Anforderungszeichens, wenn der vorbestimmte Schalter erneut betätigt wird, nachdem das Namensanforderungszeichen vorgesehen wurde.

13. Verfahren nach einem der Ansprüche 7 bis 12, wobei das Verfahren ferner den Schritt der Bereitstellung eines Anforderungszeichens umfaßt, wenn der Abstellschalter betätigt worden ist, oder wenn die Durchführung des Schrittes zum Einstellen der ersten biomedizinischen Vorrichtung in dem Lehrmodus versucht worden ist, ohne davor einen neuen Konfigurationsnamen für die neue Konfiguration zu speichern.

Revendications

1. Appareil biomédical pour commander une pluralité de dispositifs biomédicaux pouvant être programmés indépendamment et fonctionner indépendamment, chaque dispositif biomédical ayant un ensemble identique de paramètres de configuration pour commander son fonctionnement, chaque paramètre de configuration ayant une plage de valeurs que l'utilisateur peut choisir, pour avoir la même configuration, de façon à ce que les dispositifs biomédicaux puissent fonctionner indépendamment les uns des autres avec la même configuration, l'appareil comprenant :

un premier commutateur inclus dans chacun des dispositifs biomédicaux qui, lorsqu'il est activé, fournit un signal de mode enseignement ;

un second commutateur inclus dans chacun des dispositifs biomédicaux qui, lorsqu'il est activé, fournit un signal de mode apprentissage ;

un dispositif d'entrée inclus dans chacun des dispositifs biomédicaux qui sélectionne les paramètres de configuration du dispositif bio-

médical ;

une liaison de communication, qui peut être déconnectée, connectée entre deux d'une pluralité de dispositifs biomédicaux pouvant fonctionner indépendamment, qui communique les paramètres de configuration entre les deux dispositifs, de manière à ce que la liaison puisse être déconnectée des deux dispositifs biomédicaux, pour que les dispositifs biomédicaux puissent fonctionner indépendamment les uns des autres ;

un processeur inclus dans chacun des dispositifs biomédicaux qui réagit au signal de mode enseignement pour délivrer un signal de configuration représentatif d'au moins une de ses valeurs de paramètres de configuration choisies par l'utilisateur à la liaison de configuration et qui réagit au signal de mode apprentissage pour recevoir des signaux de configuration par l'intermédiaire de la liaison de communication qui configurent le dispositif biomédical en mode apprentissage de manière identique au dispositif biomédical en mode enseignement, et pour délivrer un signal par l'intermédiaire de la liaison de communication indiquant que la configuration du dispositif biomédical pouvant fonctionner indépendamment est terminée, et qui réagit aux signaux de sélection de caractères reçus du dispositif d'entrée pour assigner un nom de configuration à l'ensemble courant de valeurs de paramètres de configuration, et fournit ledit nom de configuration au dispositif biomédical en mode apprentissage ; et un affichage situé sur chacun des différents dispositifs biomédicaux réagissant au signal de configuration terminée indiquant que la configuration d'un dispositif biomédical est terminée.

2. Appareil biomédical selon la revendication 1, dans lequel chaque dispositif biomédical comprend en outre une mémoire dans laquelle sont stockées les valeurs de paramètres de configuration par défaut des autres dispositifs biomédicaux de la pluralité, dans lequel

chaque processeur réagissant au signal de mode enseignement compare chacune de ses propres valeurs de paramètres de configuration aux valeurs de paramètres de configuration par défaut stockées d'un autre dispositif biomédical auquel il est connecté et dont le processeur réagit au signal de mode apprentissage ; et

le processeur réagissant au signal de mode enseignement délivre au processeur réagissant au signal de mode apprentissage seulement les valeurs de paramètres de

configuration qui diffèrent des valeurs de paramètres de configuration par défaut stockées de l'autre dispositif biomédical, ledit processeur réagissant au signal de mode enseignement téléchargeant les valeurs de paramètres de configuration dans le processeur réagissant au signal de mode apprentissage seulement après réception d'un signal prédéterminé émis par le processeur réagissant au signal de mode apprentissage.

3. Appareil biomédical selon la revendication 2, dans lequel :

chaque dispositif biomédical comprend en outre une mémoire permanente, une mémoire non volatile et une mémoire de fonctionnement ;
chaque processeur stocke les valeurs de paramètres de configuration reçues de l'autre processeur dans la mémoire de fonctionnement ; et
lorsqu'il délivre le signal de configuration terminée, l'autre processeur stocke les valeurs de paramètres de configuration provenant de la mémoire de fonctionnement à la fois dans la mémoire permanente et dans la mémoire non volatile.

4. Appareil biomédical selon l'une quelconque des revendications précédentes, dans lequel chaque dispositif biomédical comprend en outre une mémoire dans laquelle le processeur respectif stocke le nom accompagnant l'ensemble courant de valeurs de paramètres de configuration, le processeur téléchargeant le nom vers la liaison de communication avec les valeurs de paramètres de configuration téléchargées.

5. Appareil biomédical selon la revendication 4, dans lequel :

le nom se compose de quatre caractères alphanumériques qui peuvent être choisis par l'opérateur ; et dans lequel il y a en outre un affichage qui affiche le nom en continu, que le premier dispositif biomédical soit sous tension ou non, ledit affichage comprenant un affichage à quatre caractères nécessitant relativement peu de courant d'entraînement situé sur le panneau avant du premier dispositif biomédical et affichant en continu le nom de la configuration.

6. Appareil biomédical selon la revendication 5, dans lequel chacun des dispositifs biomédicaux :

comprend en outre un détecteur de nom qui

détecte si une nouvelle configuration a été stockée dans le dispositif biomédical respectif ;
 détermine si l'opérateur a appliqué un nouveau nom à la configuration actuelle ;
 détecte si un commutateur prédéterminé a été actionné ; et, si c'est le cas, délivre un message à l'opérateur indiquant qu'un nouveau nom de configuration n'a pas encore été stocké pour la nouvelle configuration, ledit détecteur de nom désactivant le message dans le cas où l'utilisateur actionne de nouveau le commutateur prédéterminé après que le message de nom a été donné.

7. Procédé pour commander une pluralité de dispositifs biomédicaux pouvant être programmés indépendamment et fonctionner indépendamment, chaque dispositif biomédical ayant un ensemble identique de paramètres de configuration pour commander son fonctionnement, chaque paramètre de configuration ayant une plage de valeurs que l'utilisateur peut choisir, de manière à avoir la même configuration, chaque dispositif biomédical ayant un mode enseignement et apprentissage, comprenant les étapes consistant à :

mettre un premier desdits dispositifs biomédicaux en mode configuration ;
 configurer le premier dispositif biomédical avec plusieurs valeurs de paramètres de configuration choisies par l'utilisateur ;
 connecter une liaison de communication pouvant être déconnectée entre le premier dispositif biomédical et un deuxième dispositif biomédical des différents dispositifs biomédicaux pour transmettre des données de configuration entre les deux dispositifs biomédicaux ;
 mettre le premier dispositif biomédical en mode enseignement, mode dans lequel un processeur inclus dans le dispositif biomédical délivre des paramètres de configuration représentatifs des valeurs de paramètres de configuration du dispositif biomédical choisies par l'utilisateur ;
 mettre le deuxième dispositif biomédical en mode apprentissage, mode dans lequel le processeur inclus dans le dispositif biomédical reçoit les valeurs choisies par l'utilisateur des paramètres de configuration du dispositif biomédical en mode enseignement, afin de configurer le dispositif biomédical en mode apprentissage conformément à ces valeurs de paramètres de configuration choisies par l'utilisateur reçues ;
 assigner un nom de configuration choisi par l'utilisateur à l'ensemble courant de valeurs choisies par l'utilisateur de paramètres de configuration du dispositif biomédical en mode enseignement ;

stocker ce nom de configuration assigné et y associer les valeurs de paramètres de configuration choisies par l'utilisateur ;

transmettre les valeurs choisies des paramètres de configuration du premier dispositif biomédical au deuxième dispositif biomédical pouvant fonctionner indépendamment par l'intermédiaire de la liaison de communication ;
 accepter les valeurs choisies des paramètres de configuration et le nom de configuration du premier dispositif biomédical reçus par le deuxième dispositif biomédical par l'intermédiaire de la liaison de communication et configurer le deuxième dispositif biomédical en fonction de ces valeurs choisies des paramètres de configuration reçues du premier dispositif biomédical, de manière à ce que le deuxième dispositif biomédical pouvant fonctionner indépendamment ait la même configuration et le même nom de configuration que le premier dispositif biomédical pouvant fonctionner indépendamment ;

indiquer sur un affichage aux premier et deuxième dispositifs biomédicaux que le processus de commande de la configuration a été réussi ; et

déconnecter la liaison de communication entre le premier dispositif biomédical et le deuxième dispositif biomédical, de façon à ce que les premier et deuxième dispositifs biomédicaux puissent fonctionner indépendamment l'un de l'autre avec la même configuration.

8. Procédé selon la revendication 7, dans lequel l'étape consistant à transmettre les valeurs choisies des paramètres de configuration du premier dispositif biomédical comprend l'étape consistant à transmettre au deuxième dispositif biomédical seulement les valeurs des paramètres de configuration qui diffèrent des valeurs de paramètres de configuration correspondantes dans le deuxième dispositif biomédical, et dans lequel le procédé comprend en outre l'étape consistant à télécharger les valeurs des paramètres de configuration du premier dispositif biomédical dans le deuxième dispositif biomédical seulement après réception d'un signal d'identification prédéterminé émis par le deuxième dispositif biomédical.

9. Procédé selon la revendication 7 ou 8, dans lequel :

l'étape consistant à transmettre les valeurs de paramètres de configuration choisies comprend l'étape consistant à stocker dans une mémoire les valeurs de paramètres de configuration par défaut des autres dispositifs biomédicaux ;
 comparer chacune des valeurs de paramètres

- configuration du premier dispositif biomédical avec les valeurs de paramètres de configuration par défaut stockées dans ladite mémoire ; et
- transmettre au deuxième processeur seulement les valeurs de paramètres de configuration du premier dispositif biomédical qui diffèrent des valeurs de paramètres de configuration par défaut stockées. 5
- 10
10. Procédé selon les revendications 7 à 9, dans lequel l'étape consistant à configurer le deuxième dispositif biomédical comprend le fait de stocker les valeurs des paramètres de configuration reçues du premier dispositif biomédical dans une mémoire de fonctionnement dans le deuxième dispositif biomédical ; et 15
- stocker les valeurs des paramètres de configuration stockées dans la mémoire de fonctionnement dans une mémoire permanente et dans une mémoire non volatile dans le deuxième dispositif biomédical. 20
11. Procédé selon l'une quelconque des revendications 7 à 10, dans lequel l'étape consistant à assigner un nom de configuration choisi par l'utilisateur comprend le fait de : 25
- assigner quatre caractères alphanumériques en tant que nom de configuration ; et 30
- afficher en continu le nom de configuration sous tension ou hors tension, dans lequel l'étape d'affichage comprend le fait d'afficher le nom de la configuration sur un affichage à quatre caractères situé sur le panneau avant du dispositif biomédical et d'afficher en continu le nom de la configuration. 35
12. Procédé selon l'une quelconque des revendications 7 à 11, comprenant en outre les étapes consistant à : 40
- détecter si une nouvelle configuration a été stockée dans le dispositif biomédical respectif ; 45
- déterminer si un nouveau nom de configuration a été stocké qui s'applique à la configuration actuellement stockée ;
- délivrer un message si un commutateur prédéterminé a été actionné mais qu'un nouveau nom de configuration n'a pas encore été stocké pour la nouvelle configuration ; et 50
- désactiver le message dans le cas où le commutateur prédéterminé est de nouveau actionné après que le message de nom a été donné. 55
13. Procédé selon l'une quelconque des revendications
- 7 à 12, comprenant en outre l'étape consistant à délivrer un message si le commutateur de mise sous tension a été actionné ou si l'étape consistant à mettre le premier dispositif biomédical en mode enseignement a été tentée sans avoir d'abord stocké un nouveau nom de configuration pour la nouvelle configuration.

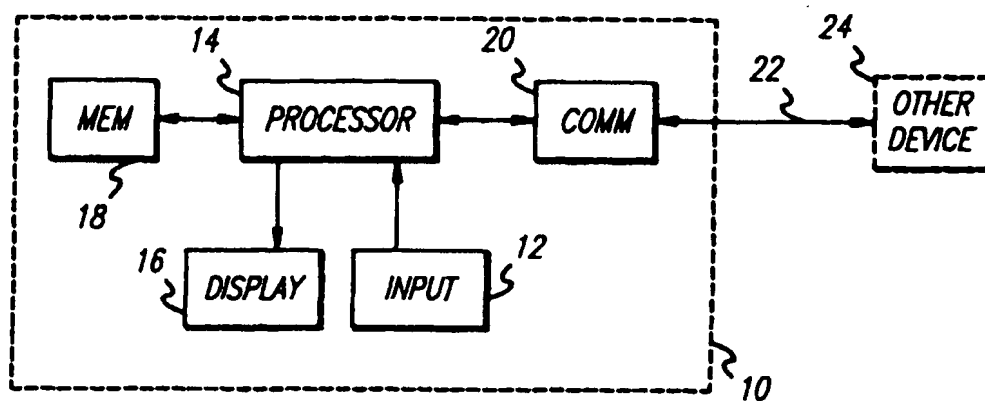


FIG. 1

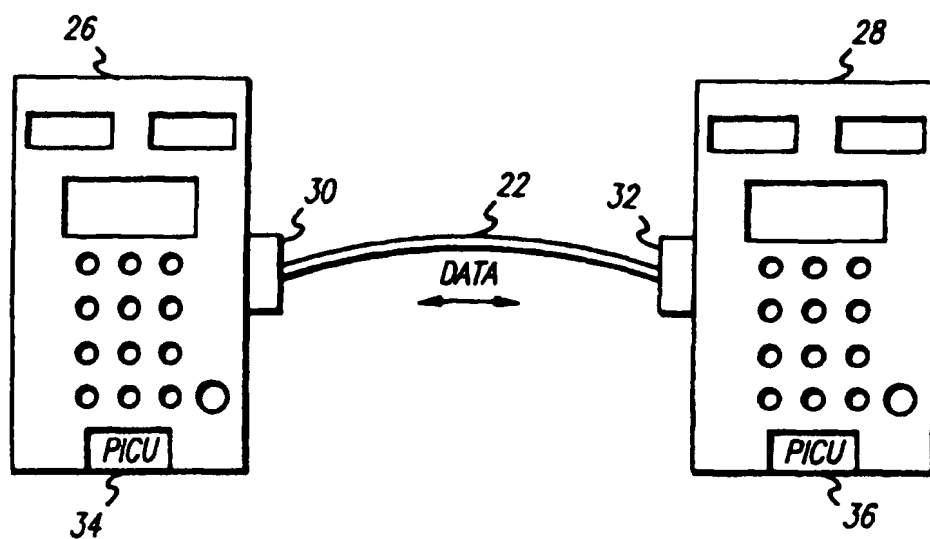


FIG. 2

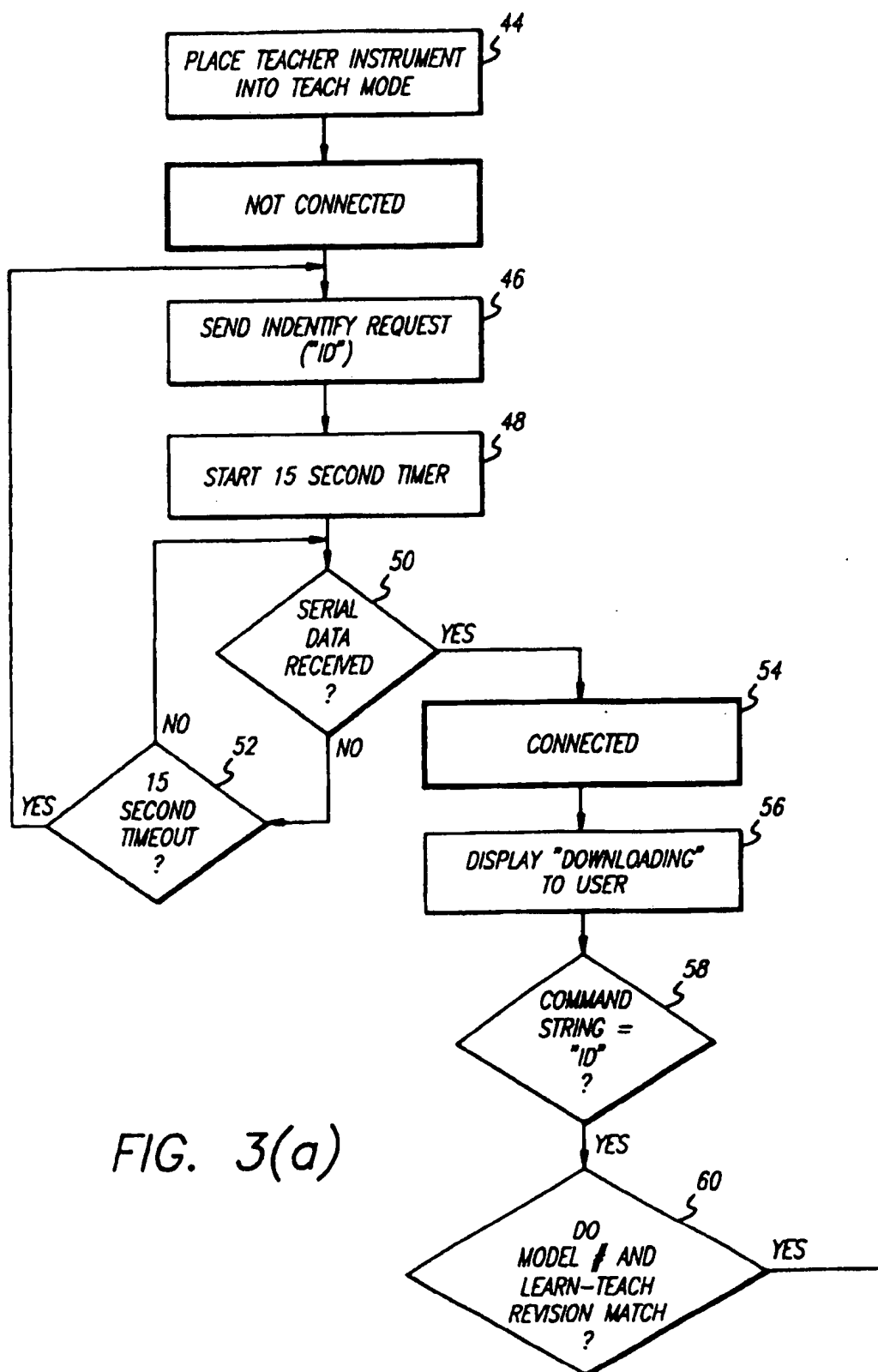


FIG. 3(b)

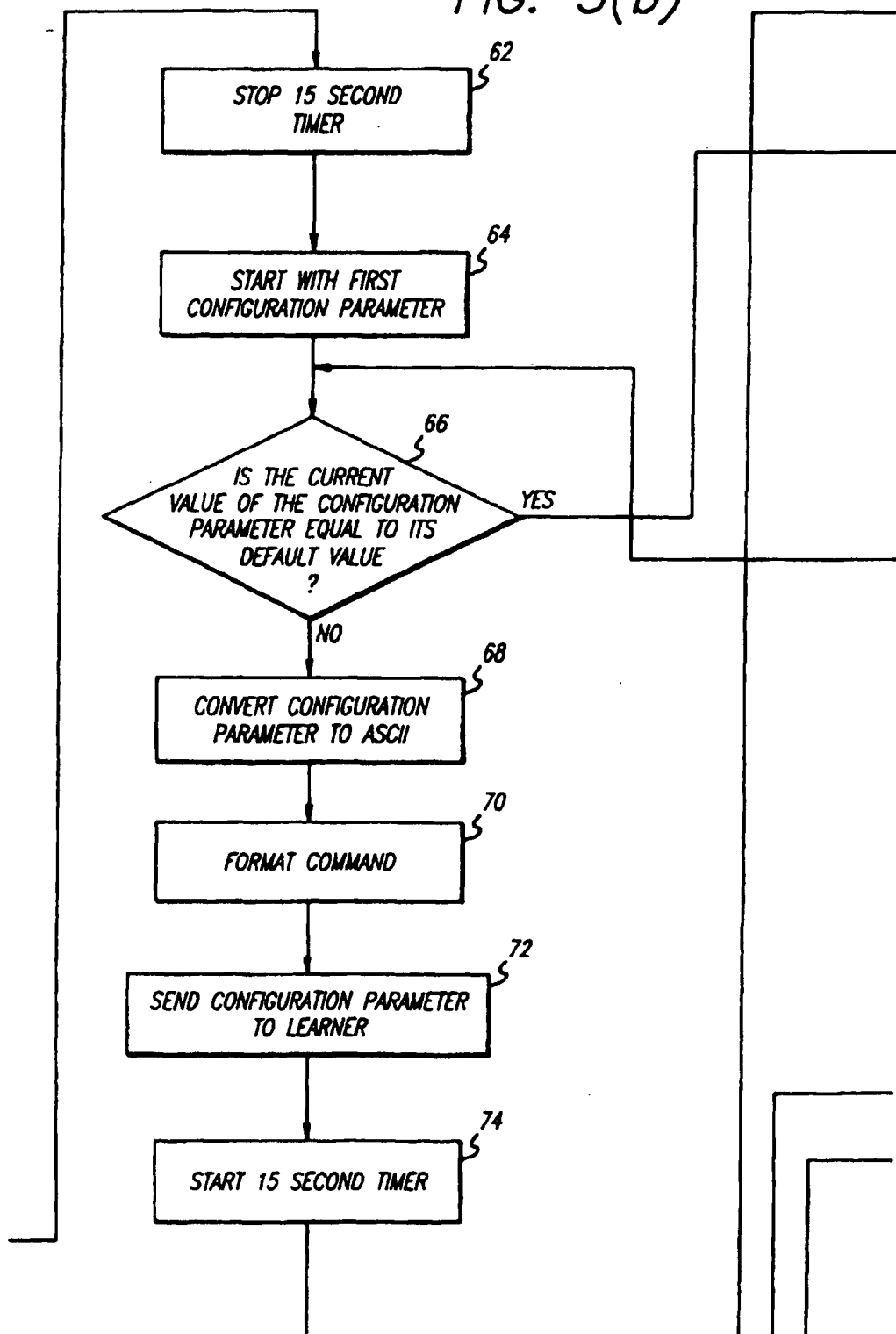
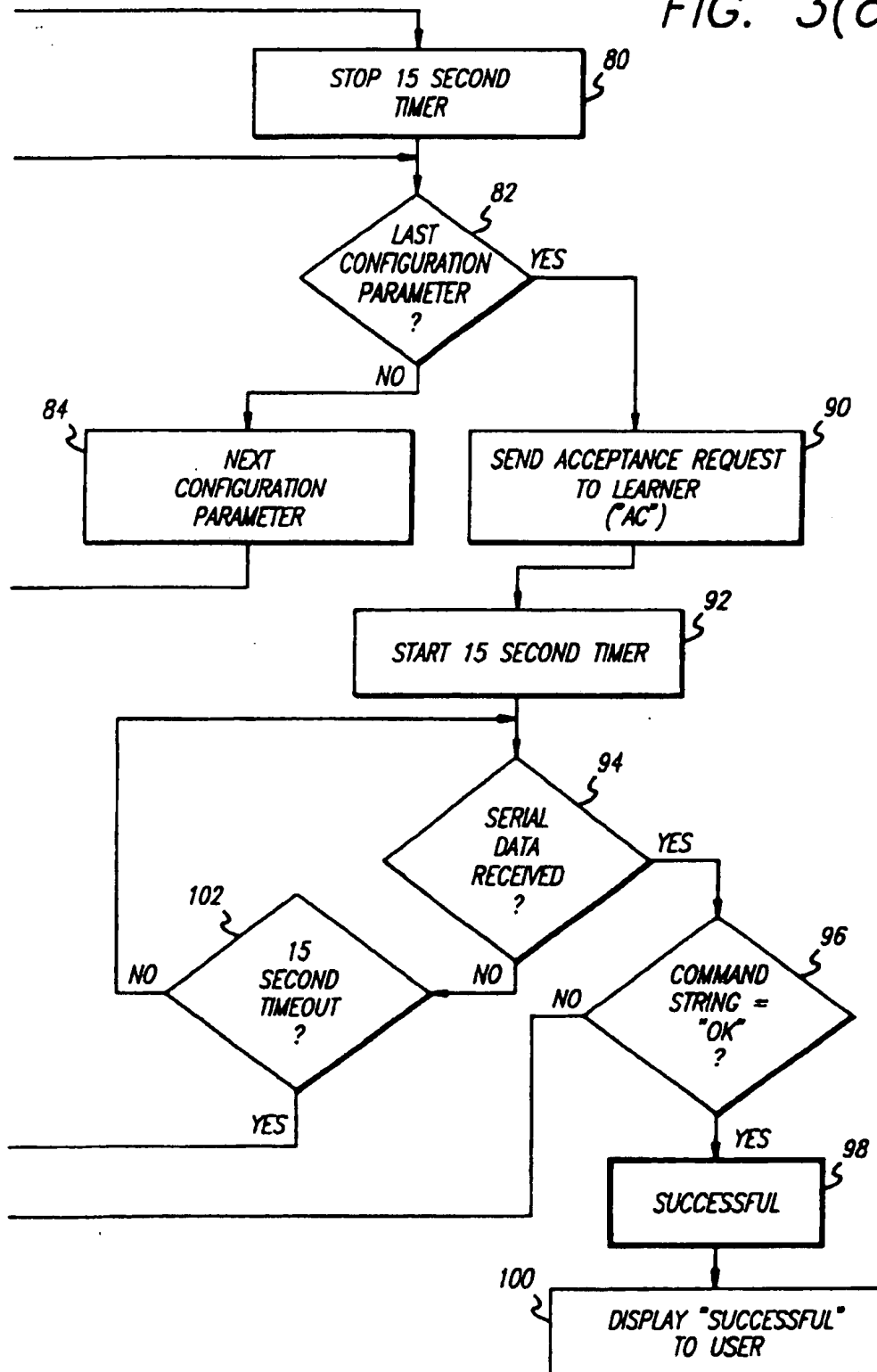


FIG. 3(c)



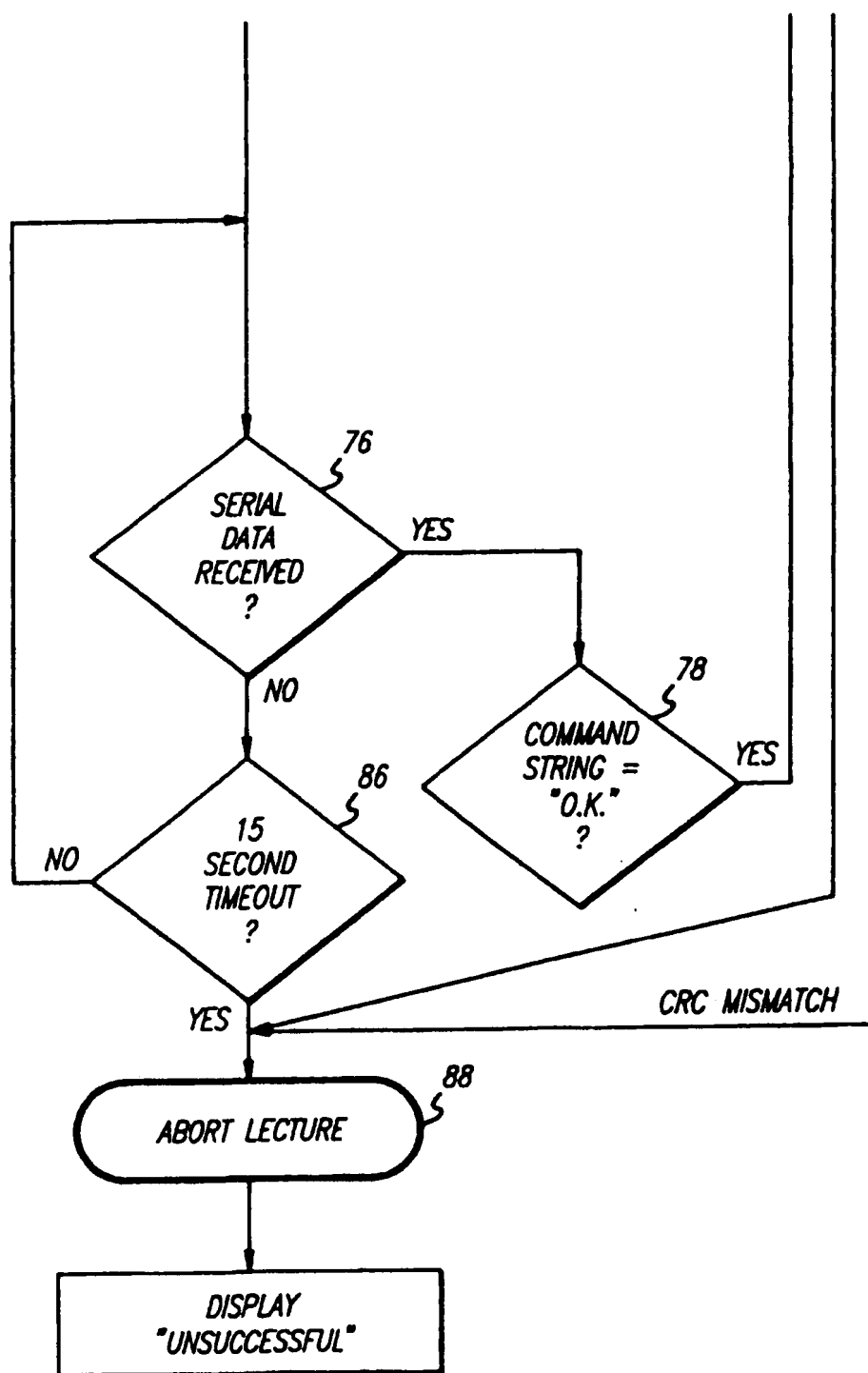
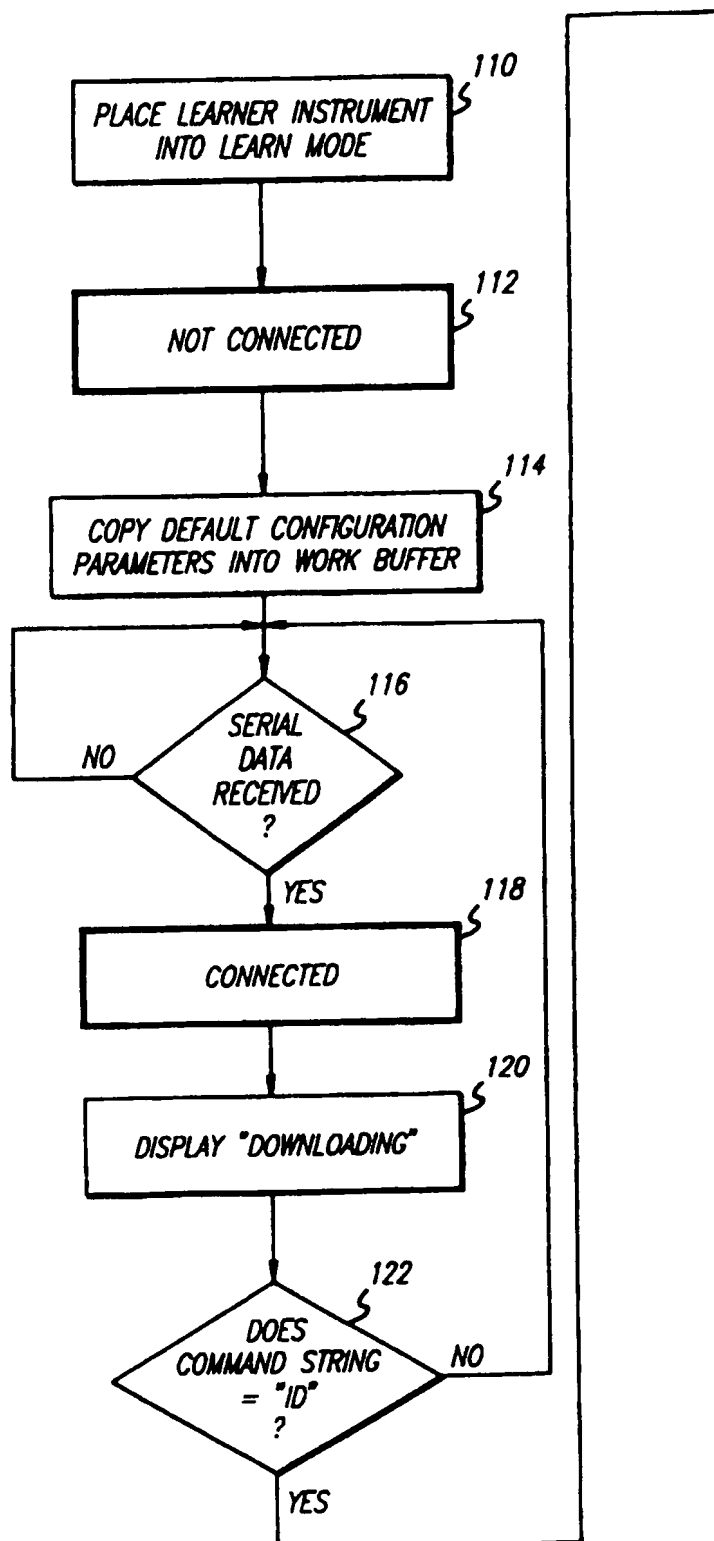


FIG. 3(d)

FIG. 4(a)



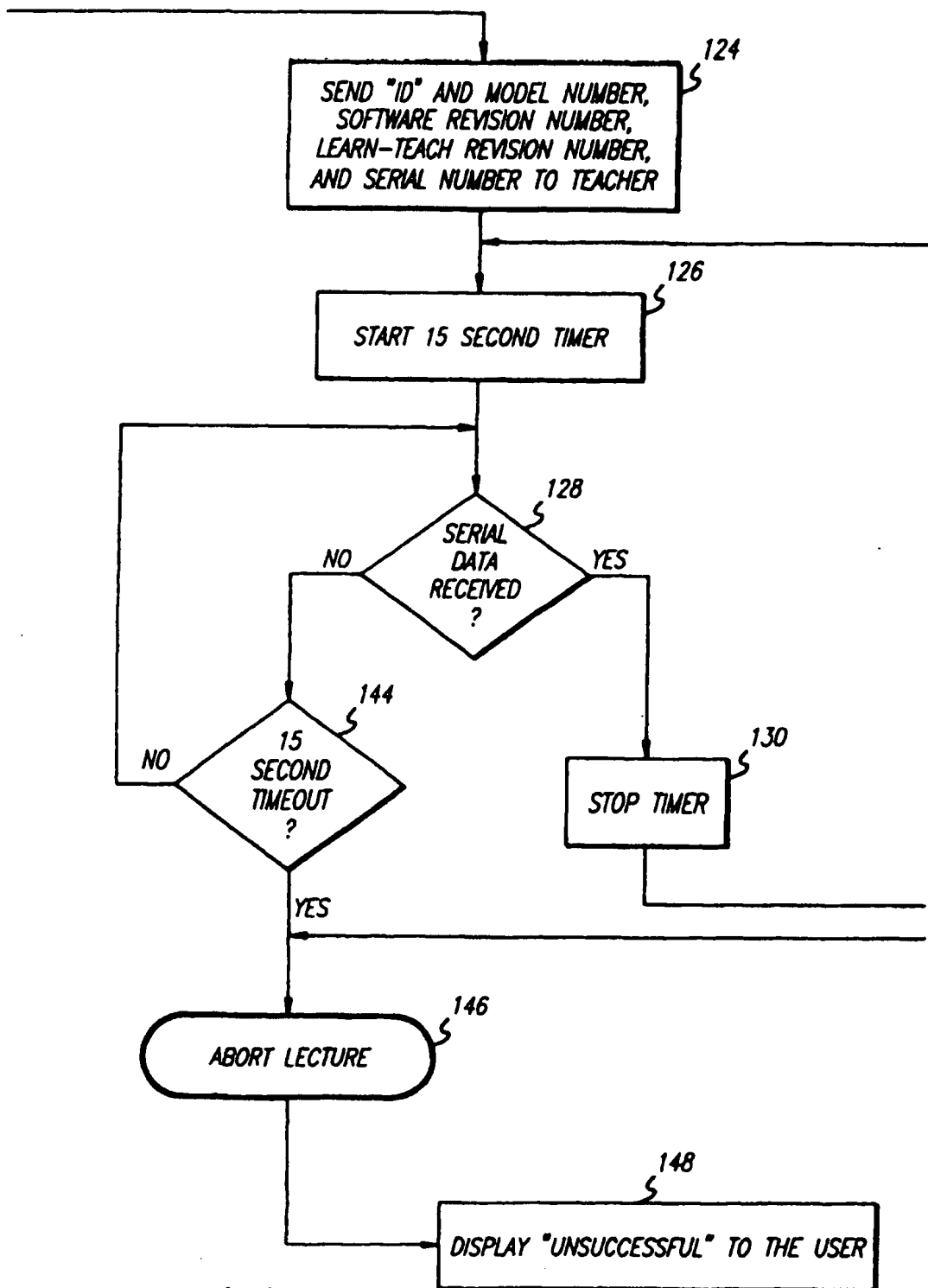
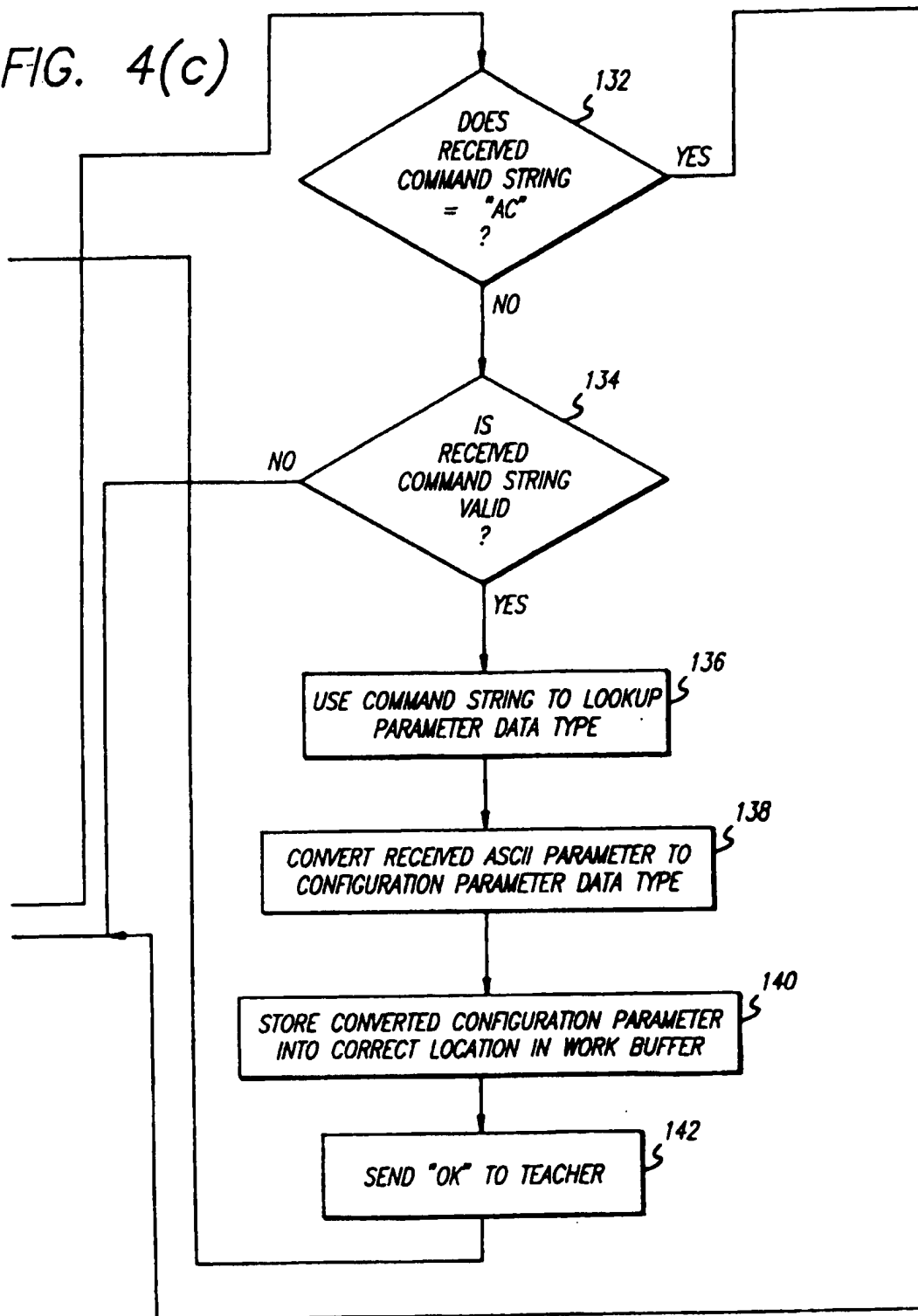


FIG. 4(b)

FIG. 4(c)



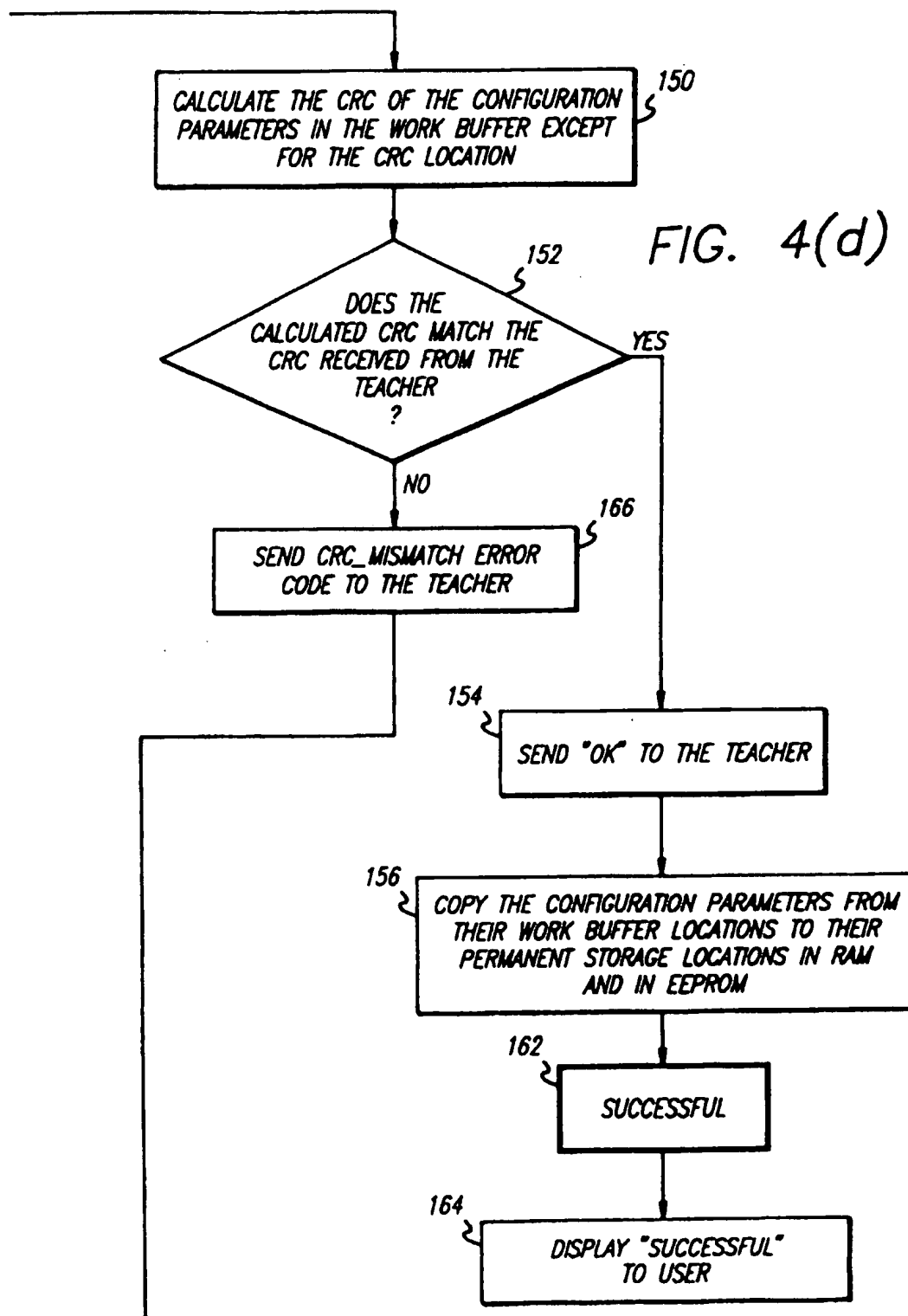


FIG. 6A

172

170

180

1

CONFIGURATION MODE

ID No. : 987654321

SW Rev. : 1.00

Config. : a9e6 PICU

more

FIG. 6B

172

5

Learn: Rev. 1.00

Teach: Rev. 1.00

more

182

FIG. 6C

172

2

Air In Line

Threshold=

50 100 200 500 mcl

Reset= On Off

cancel confirm

184

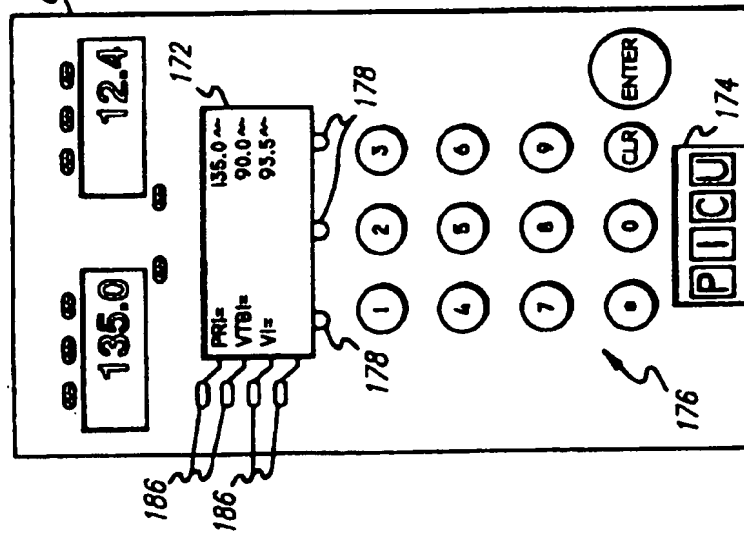


FIG. 5

FIG. 7A

172 { Teach Status
Awaiting Start

cancel start

FIG. 7B

172 { Teach Status
Downloading

cancel

FIG. 7C

172 { Teach Status
Successful
ae96 PICU

cancel try again

FIG. 7D

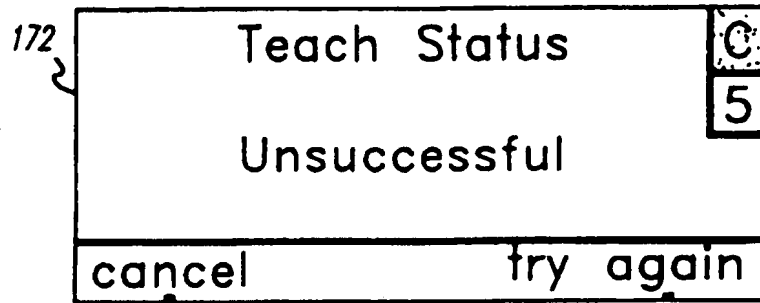


FIG. 8A

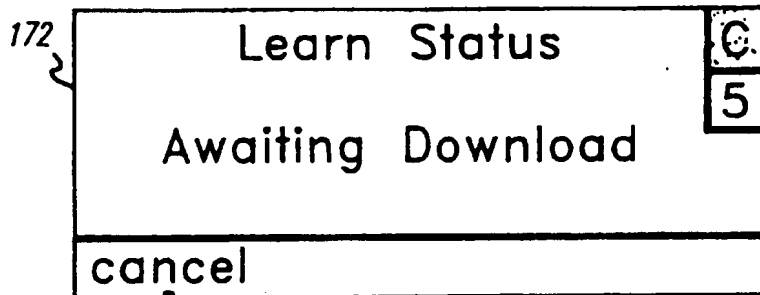


FIG. 8B

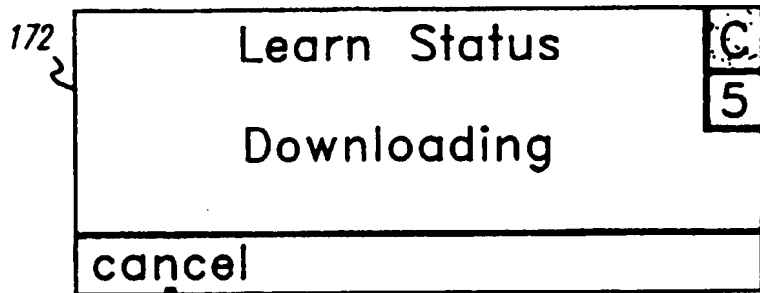


FIG. 8C

172 {

Learn Status		C
Successful ae96 PICU		5
cancel	try again	

FIG. 8D

172 {

Learn Status		C
Unsuccessful		5
cancel	try again	

FIG. 9

Configuration has been changed.		C
Press On/Off key to keep name PICU.		
cancel	rename	